(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 268 237 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 87116861.3

(22) Date of filing: 16.11.87

(51) Int. Cl.⁴: G01N 1/10 , G01N 35/00 , G01F 11/02

(30) Priority: 17.11.86 US 931476

(43) Date of publication of application: 25.05.88 Bulletin 88/21

(84) Designated Contracting States: AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: ABBOTT LABORATORIES
Abbott Park Illinois 60064(US)

(72) Inventor: Hayes, Donald J.
2012 Tampicko Drive
Plano Texas 75075(US)
Inventor: Wallace, David B.
9929 Wood Forest
Dallas Texas 75243(US)
Inventor: Verlee, Donald J.
563 Drake Street
Libertyville Illinois 60048(US)
Inventor: Houseman, Kenneth R.
1520 S. Main Street
Racine Wisconsin 53403(US)

(74) Representative: Modiano, Guido et al
MODIANO, JOSIF, PISANTY & STAUB
Modiano & Associati Via Meravigli, 16
I-20123 Milan(IT)

(54) Apparatus and process for reagent fluid dispensing and printing.

(57) A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube, comprising an orifice at one end and a fluid receiving aperture at the other end, is concentrically mounted within a cylindrical piezo-electric transducer. The fluid receiving aperture is connected to a reservoir containing a selected reagent by means of a filter. The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer and the volume defined by the jetting tube to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer and the volume of the jetting tube to de-expand, ther by causing at least a substantially uniformly sized droplet of reagent fluid to be propelled through the orifice. The droplet may be directed to impact a printing medium or collected in a dispensing recepticle.

EP 0 268 237 A2

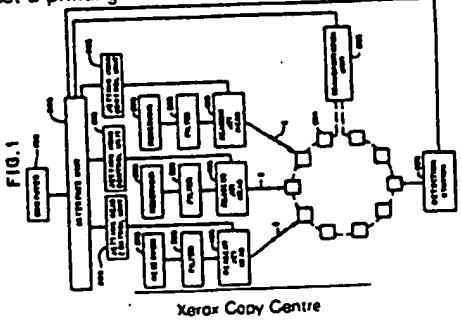


FIG. 1

APPARATUS AND PROCESS FOR REAGENT FLUID DISPENSING AND PRINTING

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and process for dispensing and printing reagent fluids, wherein a transducer is used to propel small quantities of the fluid towards a positioned target.

Diagnostic assays often require systems for metering, dispensing and printing reagent fluids. In the case of metering and dispensing, such systems comprise both manual and automatic means. For purposes of practicality, the present background discussion will focus on the methods of metering and dispensing 100 micro-liter volumes or less.

The manual systems of metering and dispensing include the glass capillary pipet; the micro-pipet; the precision syringe; and weighing instruments. The glass capillary pipet is formed from a precision bore glass capillary tube. The pipet typically comprises a fire blown bulb and a tubular portion fire drawn to a fine point. Fluid is precisely metered by aspirating liquid through the tube into the bulb to a predetermined level indicated by an etched mark. The fluid may then be dispensed by blowing air through the tube.

The micro-pipet typically comprises a cylinder and a spring loaded piston. The travel of the piston is precisely determined by a threaded stop. The distance the piston travels within the cylinder and the diameter of the cylinder define a precise volume. The fluid is aspirated into and dispensed from the micro-pipet in precise quantities by movement of the piston within the cylinder.

The precision syringe generally comprises a precisely manufactured plunger and cylinder with accurately positioned metering marks. The fluid is introduced into and dispensed from the syringe by movement of the plunger between the marks.

Weighing techniques for dispensing fluids often simply involve weighing a quantity of fluid. The density of the fluid may then be used to determine the fluid volume.

Exemplary automatic metering and dispensing systems include the precision syringe pump; the peristaltic pump; and the high performance liquid chromatography (HPLC) metering valve. The precision syringe pump generally comprises a precision ground piston located within a precision bore cylinder. The piston is moved within the cylinder in precise increments by a stepping motor.

The peristaltic pump comprises an elastomeric tube which is sequentially pinched by a series of rollers. Often the tube is placed inside a semi-circular channel and the rollers mounted on the outer edge of a disc driven by a stepping motor. The movement of the rollers against the tubing produces peristaltic movement of the fluid.

The HPLC metering valve comprises a defined length of precision inner diameter tubing. The fluid is introduced into the define volume of the tubing with the valve in a first position and then dispensed from the tubing when the valve is placed in a second position.

All of the above metering and dispensing systems have the disadvantage that the volum s dispensed are relatively large. Furthermore, these systems are also relatively slow, inefficient and comprise precision fitted components which are particularly susceptible to wear.

The printing of reagent fluids is frequently required in the manufacture of chemical assay test strips. Selected reagents are printed in a desired configuration on strips of filter paper. The strips may then be used as a disposable diagnostic tool to determine the presence or absence of a variety of chemical components.

Generally, to perform a chemical assay with a test strip, the strip is exposed to a fluid or a series of fluids to be tested, such as blood, serum or urine. In some instances, the strip is rinsed and processed with additional reagents prior to being interpreted. The precise interpretation depends on the type of chemical reactions involved, but it may be as simple as visually inspecting the test strip for a particular color change.

The manufacture of test strips generally involves either a manufacturing process or a blotting process. The blotting process is the simplest manufacturing method and permits most reagents to be applied without modification. A disadvantage of this process is that it is difficult to blot the fluids onto the test strip with precision.

The printing process will often involve any of three well known methods: silk screening; gravure; and transfer printing. The silk screening of reagents generally involves producing a screen by photographic methods in the desired configuration for each reagent to be printed. The screen is exposed under light to a preselected pattern and then developed. The areas of the screen which are not xposed to light, when devel oped, become porous. However, the areas of the screen which hav been xposed to light remain relatively nonporous. The screen is then secured in a frame and the test strip placed below. The desired

reagent fluid, specially prepared to have a high viscosity, is spread over the top side of the screen. The reagent passes through the porous areas of the screen and onto the test strip. The test strip is then subjected to a drying process, specific to each reagent. Once the test strip is dry, it may be printed again using a different screen, pattern and reagent.

The gravure method of printing reagents comprises coating a metal surface with a light sensitive polymer. The polymer is exposed to light in the desired predetermined pattern. When developed, the polymer creates hydrophilic and hydrophobic regions. The reagent is specially prepared such that when applied to the metal it will adhere only to the hydrophilic regions. After the specially prepared reagent is applied, the test strip is pressed against the metal and the reagent is transferred from the metal to the test strip.

The transfer printing method comprises transferring the reagents from a die to the test strip in the desired pattern. The die is made with the appropriate pattern on its surface and then coated with the desired, specially prepared reagent. A rubber stamp mechanism is pressed against the die to transfer the reagent in the desired pattern from the die to the rubber stamp. The rubber stamp is then pressed against the test strip to transfer the reagent, in the same pattern, to the test strip.

Each of the above-mentioned reagent printing techniques has significant disadvantages. The most common disadvantage is the requirement that the reagents must be specially prepared. Additionally, if a variety of reagents are to be printed onto a single test strip, the strip must be carefully aligned prior to each printing. This alignment procedure increases the cost and decreases the throughput of the printing process. Moreover, a special die or screen must be produced for each pattern to be printed. A further disadvantage arises in that the above printing methods are unable to place reproduceable minute quantities of reagent on the test strip.

It is an object of the present invention to provide a printing and dispensing method and apparatus which avoids these disadvantages.

SUMMARY OF THE PRESENT INVENTION

The present invention is directed to a reagent dispensing and printing apparatus and method, wherein the apparatus comprises a transducer operative to eject a substantially uniform quantity of reagent in a precise predetermined direction.

According to one preferred embodiment of the present invention used in dispensing reagent fluids, a jetting tube is concentrically located with a piezoelectric transducer. The jetting tube comprises an orifice at one end and a reagent receiving aperture at the other end. The receiving end of the jetting tube is connected to a filter which is in turn connected to a reservoir containing a selected reagent. A jetting control unit supplies an electrical pulse of short duration to the transducer in response to a command issued by a computer. The electrical pulse causes the volume defined by the jetting tube to expand by an amount sufficient to intake a small quantity of reagent fluid from the reservoir. At the end of the pulse duration, the transducer de-expands propelling a small quantity of the reagent fluid through the orifice and into a fluid recepticle. If desired, additional droplets may be deposited in the recepticle or the recepticle aligned with an additional jetting tube for receiving an additional reagent fluid.

An additional preferred embodiment of the present invention may be used for printing reagent fluids onto a print medium. In this embodiment, the jetting tube is aligned with the printing medium such that the propelled droplet impacts a precise position on the medium. The jetting tube or print medium may then be repositioned and another droplet expelled from the jetting tube. The process may be repeated until a desired configuration of the reagent fluid is printed on the medium.

One advantage of the present invention is that precise minute quantities of reagent fluid may be dispensed or printed in a reproducible manner. Additionally, the method and apparatus may be used to emit droplets of fluids having a wide range of reagent fluid viscosities and surface tensions. The reagents do not in general have to be specially adapted for use with the present invention.

The invention itself, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic representation of a first preferred embodiment of the present invention showing the use of multiple jetting heads to meter and dispense reagent fluid.

FIGURE 2a is a perspective view of a first preferred embodiment of the jetting head of the present invention.

FIGURE 2b is a cut-away perspective view of the preferred embodiment of Fig. 2a taken along lines 2b-2b with the contact pins removed.

FIGURE 2c is a sectional representation of the preferred embodiment of Fig. 2a taken along lines 2c-2c.

FIGURE 2d is a sectional representation of the preferred embodiment of Fig. 2c taken along lines 2d-2d.

FIGURE 2e is a sectional representation of the jetting tube and transducer of the preferred embodiment of Fig. 2b taken along lines 2e-2e.

FIGURE 3 is a schematic representation of a second preferred embodiment operating in the drop on demand mode as a reagent printing system.

FIGURE 4 is a schematic representation of a third preferred embodiment operating in the continuous mode as a reagent printing system.

FIGURE 5a is a schematic representation of a portion of the jetting head control unit showing the LED strobe circuit.

FIGURE 5b is a schematic representation of a portion of the jetting head control unit showing the high voltage power supply circuit.

FIGURE 5c is a schematic representation of a portion of the jetting head control unit showing the print control circuit.

FIGURE 5d is a schematic representation of a portion of the jetting head control unit showing a portion of the print pulse generator.

FIGURE 5e is a schematic representation of a portion of the jetting head control unit showing an additional portion of the pulse generator.

FIGURE 6a is a perspective view of a second preferred embodiment of the jetting head of the present invention.

FIGURE 6b is an exploded view of the preferred embodiment of Fig. 6a.

FIGURE 7 is a sectional representation of a third preferred embodiment of the jetting head of the present invention.

FIGURE 8 is a sectional view of a symmetrical portion of a fourth preferred embodiment of the jetting head of the present invention.

FIGURE 9 is a graph of the drop mass of the emitted droplets as a function of emission frequency for several fluid viscosities.

FIGURE 10 is a graph of the velocity of the emitted droplets as a function of frequency for several fluid viscosities.

FIGURE 11 is a graph of the total weight of fluid emitted as a function of the number of emitted droplets for a given fluid.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Turning now to the drawings, Fig. 1 shows a schematic representation of a first preferred embodiment of a reagent dispensing system generally represented as reference numeral 30. The dispensing system 30 comprises a plurality of reagent fluid reservoirs 200, a plurality of filters 300, a plurality of reagent jetting heads 400, a plurality of jetting head control units 500, an interface unit 600, a computer 700, transportation unit 902, a plurality of fluid mixing cells 904 and a detection station 906.

The reservoir 200 holds a selected quantity of reagent fluid for dispensing. The reservoir 200 is maintained at atmospheric pressure by suitable means such as an atmospheric vent. The reagent fluid is transferred from the reservoir 200 through the filter 300 to the reagent jetting head 400. The filter 300 is placed between the reservoir 200 and the jetting head 400 to ensure that any particular foreign matter in the reagent fluid is trapped before entering the jetting head 400.

The plurality of jetting heads 400 and the detection station 906 define a processing path. Each jetting head 400, which is described in detail below, ejects uniformly sized droplets 2 of reagent fluid. The droplets 2 are propelled, with controlled velocity and direction, towards a selecting mixing cell 904 positioned along

the processing path by the transportation unit 902. The mixing cells 904 are comprised of non-reactive material and function as minute holding tanks for the dispensed reagent fluid.

The plurality of jetting heads 400, shown in Fig. 1, are positioned sequentially along the processing path. Alternately, some or all of the plurality of jetting heads 400 may be positioned with respect to the transportation unit 902 such that the heads 400 direct the droplets 2 into a selected mixing cell 902 simultaneously.

The jetting heads 400 and the transportation unit 902 are controlled by the computer 700. The computer 700 issues commands to an interface unit 600 which is electrically connected to the transportation unit 902 and to the jetting head control unit 500. The interface unit 600 is of conventional design and is used to control the transfer of information between the computer 700 and the jetting control unit 500. The interface unit 600 is also used to control the transfer of information between the computer 700 and the transportation unit 902.

A first embodiment of the reagent jetting head is shown in Figs. 2a - 2e and generally represented by numeral 400. The jetting head 400 comprises a two piece symmetrical housing 402, 404. The housing 402, 404, when assembled, is adapted to form an orifice aperture 406, an air vent and reagent supply channel 410 and a transducer chamber 403, shown in Fig. 4b. Four screws 408, adapted to respective housing screw apertures 416, hold the housing 402, 404 in an assembled configuration.

The jetting head 400 further comprises a jetting tube 432, a piezo-electric transducer 434 and a reagent fluid supply tube 430. The jetting tube 432 defines a tapered orifice 433 at one end and a fluid receiving aperture 431 at the other end for expelling and receiving fluid, respectively. The piezo-electric transducer 434 is cylindrically shaped and secured concentrically about the mid-region of the jetting tube 432 with epoxy or other suitable means.

The piezo-electric transducer 434, shown in Fig. 2e, defines a first and second end and comprises a section of cylindrically shaped piezeo-electric material 435. An inner nickel electrode 437 covers the inner surface of the cylinder 435. The electrode 437 wraps around the first end of the cylinder 435 a sufficient distance to enable electrical connection external to the cylinder 435.

A second nickel electrode 436 covers the majority of the outer surface of the cylinder 435. The second electrode is electrically isolated from the first electrode 437 by an air gap at the face of the second end of the cylinder 435 and by an air gap on the outer surface of the cylinder 435 near the first end. When an electrical pulse is applied to the first and second electrodes 437, 436 a voltage potential is developed radially across the transducer material 435. The voltage potential causes the radial dimensions of the transducer 435 to change, which causes the volume defined by the transducer 434 to also change.

The jetting tube 432 is positioned in the transducer chamber 403 such that the receiving end 431 extends beyond the rearward end of the transducer 434. The receiving end 431 of the jetting tube 432 is inserted into one end of a reagent supply tube 430. The supply tube 430 is sealingly held to the jetting tube 432 by concentric teeth 412 formed by the housing sections 402, 404. The teeth 412 not only seal the supply tube 430 to the jetting tube 432, but, also, seal the supply tube 430 to the housing 402, 404.

The second end of the supply type 430 passes through the channel 410 and into a reagent reservoir 200. The reservoir 200 contains the reagent fluid to be dispensed by the jetting head 400. As the reagent fluid is dispensed, air is supplied to the reservoir 200 through the channel 410 to prevent the creation of a vacuum in the reservoir 200. The reservoir 200 is releasably attached to the housing 402, 404 and held in place by frictional forces. A reservoir cap 202 is flexibly attached to the reservoir 200 and adapted such that the cap 202 may be used to secure the opening in the reservoir 200 when the reservoir 200 is disengaged from the housing 402, 404.

The position of the jetting tube 432 defines the horizontal plane of the jetting head 400. The jetting tube 432 and the transducer 434 are held in a pre-defined vertical relationship with respect to th housing 402, 404 by means of two upper vertical alignment pins 418 and two lower vertical alignment pins 418. The two upper vertical alignment pins 418 extend horizontally from the housing section 402 into th transduc r chamber 403. Similarly, the two lower vertical alignment pins 418 extend horizontally from the housing section 404 into the transducer chamber 403. Each vertical alignment pin 418 is formed integrally with the respective housing sections 402, 404.

The jetting tube 432 and the transducer 434 are held in a predefined horizontal relationship with r spect to the housing 402, 404 by means of four horizontal alignment pins 424. Two of the horizontal alignment pins 424 extend horizontally from the housing section 402 approximately midway into th transducer chamber 403. Similarly, two of the horizontal alignment pins 424 extend horizontally from the housing section 404 approximately midway into the transducing chamber 403. Each horizontal alignment pin 424 is formed integrally with the r spective housing section 402, 404. The alignment pins 418, 424, sealing teeth 412 and orifice aperture 406 are aligned and adapted to hold th jetting tube 432 and transducer 434 such

that the orifice 433 of the jetting tube 432 extends into the orifice aperture 406.

An electrical transducer activation pulse is supplied to the piezo-electric transducer 434 from the jetting head control unit 500 by means of two contact pins 422. A quantity of fluid will be dispensed from the jetting tube for each applied activation pulse. The activation pulse can be produced by a variety of conventional circuits or commercially available units. Therefore a detailed description of such a circuit will not be provided. However, a circuit for producing a series of activation pulses is provided in the description of the printing embodiment below. Due to the dif fering constraints involved in dispensing and printing, the circuit in the printing embodiment is not required to produce only a single pulse. However, one skilled in the art could, if desired, modify the circuit to produce a single pulse on demand for use in the dispensing embodiment.

Each contact pin 422 defines an enlarged head 423 which is adapted to contact the respective first and second electrodes 437, 436 located on the outer surface of the transducer 434. Two contact pin holders 414, integral with the housing 402, 404, are positioned to hold the respective contact pins 422 under the pin heads 423 such that each pin head 423 electrically engages the appropriate electrode 437, 436 of the transducer 434. Two contact pin engaging posts 420 extend from the housing 402, 404 opposite the contact pin holders 414 to engage and hold the contact pins 422 against the contact pin holders 414. The ends of the contact pins 422 opposite the pin heads 423 extend through the housing 402, 404 by means of contact pin apertures 421. Since the housing sections 402, 404 are formed symmetrically to one another, the contact pins 422 may be optionally attached above the transducer 434.

In operation, the reservoir 200 containing reagent fluid is fastened to the jetting head 400 such that the fluid supply tube 430 extends into the reagent fluid. The filter 300 may be fitted to the free end of the supply tube 430 or positioned inside the reservoir 200. Air is supplied through the channel 410 around the supply tube 430 to prevent the reservoir 200 from falling below atmospheric pressure. The air is prevented from entering around the supply tube 430 and into the transducer chamber 403 by the seal created between the sealing teeth 412 and the supply tube 430. The jetting tube 432 may be primed by slightly pressurizing the reservoir 200 to cause the reagent fluid to travel through the supply tube 430 and into the jetting tube 432. Once primed, the fluid is prevented from substantially withdrawing from the jetting tube 432 by the surface tension of the reagent fluid at the orifice 433.

The transducer activation pulse is conducted to the contact pins 422 of the jetting head 400. The contact pins 422 communicate the high voltage pulse to the electrodes 437, 436 of the transducer 434 with polarity such that the concentrically mounted transducer 434 expands. The rate of expansion is controlled by the rise time of the high voltage pulse which is preset to generate a rapid expansion. The expansion of the transducer 434 causes the jetting tube 432, which is epoxied to the transducer 434, to also xpand. The expansion of the tube 432 generates an acoustic expansion wave interior to the tube 432 which travels axially towards the orifice 433 and towards the fluid receiving aperture 431. When the expansion wave reaches the orifice 433, the reagent fluid is partially drawn inwardly. However, the surface tension of the fluid acts to inhibit substantial inward fluid movement.

When the expansion wave reaches the end 431 of the tube 432, the expansion wave is reflected and becomes a compression wave which travels towards the center of the piezo-electric tube 434. The high voltage pulse width is adapted such that when the reflected compression wave is beneath the piezo-electric tube 434, the high voltage pulse falls, resulting in a de-expansion of the transducer 434 and the jetting tube 432. This action adds to the existing acoustic compression wave in the interior of the jetting tube 432. The enhanced compression wave travels toward the ori fice causing reagent fluid to be dispensed from the tube 432. The fluid is propelled from the orifice 433 as a small droplet 2 and deposited in the selected mixing cell 904 positioned by the transportation unit 902. One droplet 2 is dispensed for each transducer activation pulse. This mode of dispensing is referred to as the drop on demand mode.

In some instances, the droplet 2 may be accompanied by at least one smaller satelite droplet. However, even if satelite droplets are present, the volume and velocity of the reagent droplets 2 are highly reproduceable. This reproduceability allows for precise dispensing of uniform, controllably sized droplets 2 of reagent fluid into the mixing cell 904.

The droplets 2 of reagents impact the mixing cell 904 with sufficient force and volume to cause fluidic mixing of the reagents. Once the desired amounts of the selected reagents are deposited in the selected mixing cell 904, mixing cell 904 is transported to the detection station 906 where the mixed reagents may be extracted for use or analyzed for assay r sults.

The dispensing system 30 provides numerous advantages based upon the ability of the reagent jetting head 400 to rapidly and reproduceably eject uniform quantities of a wide range of reagents. The reaction times of some chemical processes are dependent upon the volume of the reagents used. Th ability of the dispensing system 30 to dispense such minute amounts of reagents thereby reduces the processing time

of certain chemical assays. Furthermore, some chemical assays require a wide range of dilution ratios. Many conventional dispensing systems are unable to dispense the reagents in volume small enough to make the desired assay practical. The dispensing system of the pres ent invention overcomes this disadvantage.

In addition to dispensing reagent fluids, certain embodiments may be used for precision printing of reagents onto a printing medium such as filter paper to produce an assay test strip. A printing system 10 using the present invention is represented in Fig. 3. Structure similar in form and function to structure described above will be designated by like reference numerals. The printing system 10 comprises a reagent fluid reservoir 200, a filter 300, a reagent jetting head 400, a jetting head control unit 500, an interface 600, a computer 700, and an x-y plotter 800.

The x-y plotter 800 is a commercially available pen plotter, mechanically modified in a conventional manner such that the pen is replaced with the jetting head 400. The general operation and structure of the plotter 800 will not be described in detail. The plotter 800 accepts commands from the computer 700 thru a standard RS-232 serial interface contained within the interface unit 600. The plotter 800 processes the commands and produces control signals to drive an x-axis motor (not shown) and a y-axis motor (not shown). The x-axis motor is used to position the jetting head 400 and the y-axis motor is used to position a drum (not shown) to which the printing target 1 is attached.

The plotter 800 produces a pen down signal PENDN. This signal is applied to the control unit 500 and indicates that the plotter 800 is ready to begin a printing operation.

The control unit 500 also receives control signals from the interface unit 600. These signals include signals HIGHER*, LOWER* to control the magnitude of the pulse applied to the transducer 434; a reset signal RST to reset the control unit 500; and a series of print signals PRT*. The generation of these signals will not be described in detail since their production is performed by the conventional interface unit 600.

The jetting head 400 and fluid supply system 200, 300 are initialized and operate substantially as described above. The jetting head control unit 500, shown in Figs. 5a - 5e comprises a print control circuit 510, a pulse generator 530, a high voltage supply 540, and a strobe pulse generator 560. The control unit 500 also comprises a power supply. However, since the power supply is of conventional design it will not be shown or described in detail.

The print control circuit 510 receives the pen down signal PENDN from the plotter 800 and comprises a transistor Q100, a one-shot circuit U100, two NAND-gates U101, U102, a line decoder multiplexer U107 and four inverters U103-U106. The pen down signal PENDN is applied to the base of the transistor Q100 by resistors R100, R101 and diode D100. The emitter of transistor Q100 is tied to ground and the collector is connected to the +5 volt supply by resistor R102.

The one-shot U100 comprises inputs A, B and an output Q. The B input of the one-shot U100 is connected to the collector of the transistor Q100 and the A input is tied to ground. The time period of the pulse produced by the one-shot U100 is determined by a resistor R104, a variable resistor R105 and a capacitor C100. The output Q of the one-shot U100 is combined with the collector output of the transistor Q100 by the NAND-gate U101 and then inverted by the NAND-gate U102. The circuit is operative to produce an adjustable delay in the application of the pen down signal PENDN to the control unit 500.

The line decoder U107 is circuited to function as a 3 input AND-gate. The output of the NAND-gate U102 is applied to the first input of the decoder U107; the print signal line PRT* comprising a series of pulses from the interface unit 600 is applied to the second input; and a jetting head ON/OFF signal from switch S1 is applied to the third input. The inverter U106 inverts the output of the line decoder U107 to generate the print control signal PRT* and the inverters U103-U105 invert the control signals LOWER*, HIGHER*, and RST signals, respectively.

The high voltage supply 540, shown in Fig. 5b, provides +175 volts DC to produce a maximum pulse of +150 volts peak to peak at the reagent jetting head 400. The high voltage supply 540 comprises differential amplifier U12 and transistors Q1, Q2, Q13, Q14. A stable reference voltage of -2.5 volts DC is produced at the junction of a reservoir R13, connected to the -15 volt supply, and a diode CR6, connected to ground. The reference voltage is combined with a resistor R14 to produce an adjustable, stable voltage reference for the amplifer U12. The reference voltage is applied to the inverting input of the amplifier U12 through a resistor R11. The noninverting input of the amplifier U12 is connected to ground by a resistor R12. The amplifier U12, in combination with a feedback resistor R10, produces an output signal proportional to the difference of the voltage reference signal and the ground pot ntial.

The output of the amplifier U12 is applied to the base of the transistor Q2 whose collector is connected to the +15 volt supply. The signal produced at the emitter of the transistor Q2 is applied to the bas of the transistor Q1 through resistors R8, R6, R5, a transformer L1 and diodes CR4, CR2, CR1. The emitter of the transistor Q1 is connected to ground and the collector is connected to the +15 voltage supply through the

transformer L1. A diode CR3 connects the collector of the transistor Q1 to the junction of the resistor R5 and the diode CR4. The transistor Q1 is biased for proper operation by resistors R7, R6, R5. The resistor R7 and a capacitor C22 connect the junction of the resistor R8, R6 to the +15 voltage supply.

The transistor Q1 and the transformer L1 form a "flyback" blocking oscillator. Any increase in current supplied by the transistor Q1 produces an increase in energy transferred through the secondary winding of the transformer L1 and diode CR5. Therefore, an increase in current supplied by the transistor Q1 results in an increase in power available to the high voltage output. The diodes CR1-CR4 form a "Baker clamp" which prevents transistor Q1 from saturating. The clamp thereby avoids transistor storage time.

The diode CR5 is connected to a multiple pi filter formed by the inductors L3, L2, capacitors C24, C21, C41 and resistors R29. The multiple pi filter attenuates ripple and switching spikes in the signal supplied to the transistor Q13 which produces the high voltage output V++. A resistor R64 connects the base of the transistor Q13 to the emitter and to the resistor U29. The base is also connected to the collector of the transistor Q14 by a resistor R65. The base of the transistor Q14 is connected to the +15 volt supply by a resistor R67 and to ground by a resistor R66. The emitter of the transistor Q13 provides a signal HV SENSE which is fed back to the inverting input of the amplifier U12 through a resistor R9. The high voltage output V++ is produced at the collector of the transistor Q13. The proper biasing of the transistor Q13 is provided by resistor R64 and the biasing circuit comprising the transistor Q14, resistors R67, R66, R65.

The pulse generator 530, shown in Figs. 5d, 5e, comprises an opto-isolator U18, a one-shot U23, a digital to analog (D/A) converter U30 and two binary counters U24, U25. The pulse generator 530 accepts control signals PRT*, LOWER*, HIGHER*, RST and produces the activation pulse which is applied to the transducer 434. In normal operation, the PRT* control signal is supplied to the opto-isolator U18 by a jumper JMP between contact points E5, E6. The opto-isolator U18 is of conventional design and comprises a light emitting diode (LED) circuit and a photo-element circuit. A resistor R15 operates as the load resistor for the LED circuit of the isolator and a capacitor C25 suppresses transient noise on the voltage supply to the isolator U18. The output of the isolator U18 is applied to one input of the one-shot U23 whose time constant is adjustably determined by resistors R38, R25 and a capacitor C30. The pulse from the non-inverting output of the one-shot U23 is fed to the base of a transistor Q9. A resistor R39 sets the approximate base current of the transistor Q9 which is used as a level shifter for converting the CMOS signal level to the +15 volt DC signal level.

The control of the rise and fall rates of the pulse generator 530 is accomplished by directing a pair of current source transistors Q11, Q12 to charge and discharge a capacitor C57. The transistor Q11 is operative as a source of current and the transistor Q12 is operative as a sink for current. A transistor Q10 controls the level of the current by applying an appropriate bias current through a resistor R56 to the base of the transistor Q11. The biasing of the transistors Q11, Q12 is critical to the proper rise and fall rates. Therefore precision voltage references CR13, CR15 are used to provide respective bias reference voltages. A temperature compensation network is formed from zener diodes CR14, CR16 and resistors R55, R54 to maintain stable operation of the transistors Q11, Q12, respectively. The variable resistors R49, R52 may be used to adjust the fall time and rise time, respectively, of the output pulse applied to the reagent jetting head 400. A plurality of resistors R45, R46, R47, R48, R49, R51, R52, R53, R56, R57, R58 are used to properly bias the transistor Q10, Q11, Q12 and capacitors C55, C60 are circuited to maintain stability of the circuit.

The impedance of the output stage of the rise and fall circuitry Q10, Q11, Q12 is very high. With such a high impedance, circuit elements attached to the capacitor C57 could affect the linearity of the rise and fall time constants. Therefore, an FET input operational amplifier U32 is used as an impedance interface. The amplifier U32 is configured in the noninverting mode and circuited with capacitors C58, C59 for stability.

The output of the amplifier U32 is applied to an inverting amplifier U31 by means of a resistor R62. The amplifier U31 inverts and conditions the pulse control signal with the aid of resistors R59, R60. Resistors R61, R63, connected to the -15 voltage supply, provide a means for adjusting the DC level offset of the amplifier U31 output signal. Capacitors C51, C52 are connected to enhance the performance and stability of the circuit.

The output of the amplifier U31 is applied by means of a resistor R41 to the positive voltage reference signal input REF(+) of the D/A converter U30. The negative voltage reference signal input REF(-) is tied to ground by a resistor R40. The D/A converter U30 produces output signals IOUT, IOUT* which are proportional to the difference between the positive and nega tive voltage reference signal inputs REF(+). REF(-). Capacitors C48, C49, C50 are connected to the D/A converter U30 to enhance stability.

The D/A converter outputs IOUT, IOUT* are also proportional to an 8-bit binary value applied to inputs B1-B8. The binary value is supplied by the counters U24, U25 which are controlled by the function signals LOWER*, HIGHER* and RST. The LOWER* signal and the HIGHER* signals are applied to the count up and

count down inputs CU, CD of the counter U24 by means of opto-isolators U19, U20. The carry and borrow outputs CY, BR of the counter U24 are connected with the count up and count down inputs CU, CD of the counter U25. The reset inputs RST of both counters U24, U25 receive the RST signal by means of an opto-isolator U21. Resistors R16, R17, R18 are used as load resistors for the LED circuits of the isolators U19, U20, U21 and capacitors C26, C27, C28 are used to enhance the stability of the isolator circuits.

The counters U24, U25 may optionally be preloaded to the selected 8-bit binary value through input lines TP0-TP7. The input lines TP0-TP7 are normally biased to the logical high signal state by resistive network U22. The selected binary value is loaded into the counters U24, U25 by pulling the respective inputs TP0-TP7 low and applying an external, active low, load signal EXT LOAD to pin TP8. The load signal pin TP8 is connected to the load inputs LOAD of the counters U24, U25 and conditioned by a clipping circuit comprised of diodes CR9, CR10 and a pull-up resistor of the resistor network U22.

The noninverted and the inverted outputs IOUT, IOUT" are connected to the inverting and noninverting inputs of a differential amplifier U29. The output of the amplifier U29 is fed back to the invert ing input by a resistor R50. The amplifier U29 converts the current output of the D/A converter U30 to a voltage output. Capacitors C56, C47 are provided to enhance circuit stability.

The output of the amplifier U29 is applied to the noninverting input of the amplifier U28. The output of the amplifier U28 is fed back to the inverting input by means of a capacitor C46 and a resistor R37. The inverting input is also connected to ground by a resistor R36. To enhance the frequency response of the amplifier U28, a resistor R43 and a capacitor C54 are connected between the frequency compensation input FC and ground. An adjustable DC offset is provided by connecting the output offset inputs OF, OF with a variable resistor R42. The wiper of the resistor R42 is connected to the high voltage power supply output V+ +.

The output of the amplifier U28 is also connected to the base of a transistor Q4 and through diodes CR11, CR12 to the base of a transistor Q7. The transistor Q4, Q7, Q3 and resistors R30-R35 form an output circuit capable of driving high capacitive loads at high slew rates and wide bandwidth. The variable resistor R31 may be used to set the maximum current through the bias network R30, R33 by measuring the v ltage drop across resistor R35.

The strobe generator 560 produces a strobe pulse and comprises transistors Q101-Q105 and a one-shot circuit U108. The strobe intensity is determined by the circuit comprising the transistors Q101-Q104 and resistors R109-R115. The circuit is connected to the anode of the LED 900 and receives two inputs from the interface unit 600 to produce four levels of light intensity in the LED 900.

The activation aand duration of activation of the LED 900 is determined by the one-shot U108 and the transistor Q105. The one-shot U108 comprises inputs A, B and an output Q. The strobe signal STROBE is applied to the B input from the interface unit 600. The duration of the one-shot U108 output pulse is controlled by the adjustable RC network R107, R108. The output Q is applied to the base of th transistor Q105 by resistor R108. The collector of the transistor Q105 is connected to the cathode of the LED 900 to draw current through the LED 900.

The computer 700, control unit 500 and plotter 800 must be initialized. The initialization of the computer 700 and the plotter 800 will not be discussed since these units are of conventional design and operation.

To initialize the jetting head control unit 500, the computer 700 directs the interface unit 600 to issue a reset command. The reset signal RST is conducted to the control unit 500 whereupon the counters U24, U25 are cleared. The computer 700 then retrieves from its memory, or by conventional operator input, the desired digital setting for the D/A converter. This setting may also be calculated from data and may be tailored to specific sizes of jetting heads 400 or reagent fluids. The computer 700 then issu s a series of commands, threugh the interface unit 600, to increment or decrement the counters U24, U25 to correspond to the desired binary setting. If the command directs that the counters are to be raised, then th HIGHER" signal is applied through the opto-isolator U20 to the count up CU input of the counter U24. Similarly, if the command directs that the counters are to be lowered then the LOWER" signal is applied through the opto-isolator U19 to the count down CD input of the counter U24. Since the carry and borrow outputs CY, BR of the counter U24 are connected to the count up and count down inputs CU, CD, respectively, of the counter U25, the digital setting applied to the D/A converter U30 may range from 0 to 255. Alternately, the counters U24, U25 could be initialized to a desired setting by loading the binary value on the lines TP0-TP7 and strobing the EXT LOAD line..

Once the control unit 500 and the plotter 800 ar initialized, the printing cycle may begin. The computer 700 issues a command to th interface unit 600 to produce the s ries of PRT" signal pulses. The computer 700 then commands the plott r 800 to print, for example, a line along a s lect d path. The plotter 800 positions the jetting head 400 and target 1 and issues the pen down signal PENDN. The signal is delayed by the print control circuit 510 to ensure that the target 1 is properly positioned. At the xpiration of the

delay, the signal is ANDed with the closed enable switch S1 and the series of print pulses PRT". The result of the AND operation is the application of the PRT" pulses to the pulse generator circuit 530.

The PRT" signal is applied through the jumper JMP to the opto-isolator U18 and then to the one-shot U23. The one-shot U23 produces a pulse signal which is then converted from CMOS signal levels to the 15 volt DC signal level by the transistor Q9. The rise and fall circuitry comprising Q10, Q11, Q12 converts the square wave pulse into a pulse having the rise and fall characteristics preset by the resistors R49, R52. The conditioned pulse is then amplified by the amplifier U32 and applied to the amplifier U31.

The amplifier U31 converts the polarity of the conditioned pulse to that acceptable by the D/A converter U30 and supplies an adjustable DC offset. The DC offset is used to counteract possible distortion attributable to the amplifier U31. The distortion arises in that, for the amplifier U31 to be adequately responsive, a small degree of current must flow through the resistor R41. This current creates an offset condition at the output of the amplifier U29 which is then scaled by the D/A converter U30 in correspondence with the binary data. The resistor R63 allows a small amount of current to be applied to the amplifier U31 to control the offset voltage attributable to the current flowing through the resistor R41.

The D/A converter U30 scales the difference between the inputs REF(+), REF(-) using the binary data supplied to input lines B1-B8 to produce a current output pulse IOUT and a current inverted output pulse IOUT". The two outputs IOUT, IOUT" are fed to the amplifier U29 which convert the current outputs into a single voltage output. The scaled, conditioned pulse is then applied to the output circuit comprising the amplifier U23 and the transistors Q3, Q4, Q5, Q6, Q7. The circuit produces a high voltage pulse with the aforementioned rise and fall characteristics to drive the piezo-electric transducer 434.

The high voltage pulse is applied to the transducer 434 and causes a droplet 2 of fluid to be propelled onto the target 1. Since the pen down signal PENDN is still applied, additional droplets 2 are produced from the jetting head 400. The plotter 800 moves the jetting head 400 and target 1 along the desired path during the emission of the droplets 2 to produce the desired printed line. When the printing is complete, the plotter 800 removes the pen down signal PENDN and the droplet emission stops. Of course it should be understood that dots, circles and the like could be produced by appropriate positioning of the target 1 and jetting head 400.

The size and uniformity of the droplets 2, as well as the presence of any satelite droplets, may be observed with the aid of the scope 950 and the LED 900. The scope 950 and the LED 900 are positioned such that the droplets 2 pass between the scope 950 and the LED 900 and within the focal range of the scope 950. The strobe pulse when applied to the LED 900 causes the LED 900 to momentarily flash. The timing of the activation and the width of the pulse may be adjusted such that the flash occurs when the fluid, expelled in response to the high voltage pulse, is between the scope 950 and the LED 900. The dispensed quantity of fluid may then be observed in flight or at or near the momement of separation from the orifice 433. Corrections based on the observation may then be made to the system 10. .

Since each droplet 2 is small in volume, the droplet 2 may be rapidly absorbed by the target 1, thereby allowing rapid and precise placement of a variety of reagents on the target 1 with reduced drying time and reduced potential of fluidity mixing. In addition, the ability to place small droplets 2 in a precise manner enables the target 1 to be printed in a high density matrix with a variety of reagents as isolated matrix elements.

In some printing applications, particularly when printing fluids of flow viscosity and surface tension, it may be desirable to force the fluid through the jetting tube 432 under pressure and allow the vibrations produced by the transducer 434 to break the emitted fluid stream into precise droplets 2. Under this mode of printing, the emission of droplets 2 can not be stopped by cessation of the tranducers activation pulse. It is therefore necessary to prevent fluid emission by other means. One preferred means of momentarily stopping emission of the droplets is shown schematically in Fig. 4. In this arrangement, structure similar to structure represented in Fig. 3 in form and function, is represented by like reference numerals.

The arrangement, generally represented by the numeral 20, includes a closed reagent recirculation system comprising a normally close three way valve 970, a sump 960 and a recirculation pump 980. In the continuous mode, the reagent fluid is forced out the orifice 433 by hydraulic pressure and broken into a series of substantially uniform droplets 2 by movement of the transducer 434. A regulated, filtered air supply 100 is used to pressurize the reagent fluid reservoir 200. The reagent fluid within the reservoir 200 may optionally be agitated by a magnetic stirer unit 990. This is especially useful for r agent fluids comprising suspended particles.

The three-way valve 970 comprises a common channel, a normally open channel and a normally closed channel. The fluid is forced through the filter 300 and applied to the normally closed channel of the valve 970. When the normally closed channel is closed, the normally open channel of the valve 970 functions as a vent for the reagent jetting head 400. The common channel is connected to the reagent supply tube 430

of the jetting head 400. The reagent supply tube 430 is also connected to the sump 960.

In operation, the normally closed channel is opened by an appropriate signal supplied by the computer 700 which also closes the normally open channel. When the normally closed channel is opened, fluid is permitted to pass to the sump 960 and to the jetting head 400. The sump 960 collects the reagent fluid not transferred to the jetting head 400. The sump 960 supplies the collected fluid to the inlet side of the recirculating pump 980 which returns the fluid to the reservoir 200. The returned fluid is then mixed with the contents of the reservoir 200 and is available for recirculation.

When operating in the continuous mode, rather than interrupt the continuous stream of print pulses to the jetting head 400, the printing may be momentarily stopped by closing the normally closed channel of the valve 970. The closing of the normally closed channel stops the flow of reagent fluid to the jetting head 400 and allows the jetting head 400 to vent to atmospheric pressure. With the fluid supply blocked, the transducer 434 is unable to expel further droplets 2. Thus, if positioning of the target 1 by the plotter 800 requires a longer time interval than the time between droplet 2 emission, the computer 700 may close the normally closed channel of the valve 970. The plotter 800 may then position the target 1 or position a new target 1 as desired.

When printing, the active ingredient of the reagent is tailored to achieve a desired concentration per unit area on the target 1. However, to a certain extent the final concentration per unit area can be adjusted by varying the density of the droplets 2 printed on the target 1. The preferred embodiment is particularly well suited to this application due to its ability to print precise, discrete pels of reagent.

A second preferred embodiment of the jetting head is illustrated in Figs. 6a-6b and is generally represented as 400'. The jetting head 400' comprises housing formed into three sections 401', 402', 403'. The housing section 403' comprises a recessed region which forms the reagent fluid reservoir 200' when the housing section 403' is positioned against housing section 402'.

The jetting head 400' further comprises a piezo-electric transducer 434' and a reagent jetting tube 432' similar to those of the first embodiment. The jetting head 400' and the transducer 434' are most clearly shown in Fig. 6b. The jetting tube 432' defines an orifice 433' at one end and a reagent fluid receiving aperture 431' at the other end. The transducer 434' is mounted to the jetting tube 432' concentrically about the mid-region of the tube 432' with epoxy.

The transducer 434' and the jetting tube 432' are positioned in channels 420', 418', 416' located in the housing sections 402', 401'. The channel 416' comprises a plurality of sealing teeth 412' operative to engage and seal against the fluid receiving end 431' of the jetting tube 432'. The channel 416' is connected to the reagent fluid supply channel 430'. The supply channel 430' is connected with the fluid reservoir 200' by means of an aperture 431' through the housing section 402', shown in Fig. 6b.

The reservoir 200' comprises a flexible reservoir lining 201' adapted to contain the reagent fluid. The lining 201' comprises one aperture which is connected to the housing 402' to allow the fluid to pass from the lining 201'. A vent (not shown), located in the housing 403', allows the space between the reservoir 200' and the lining 201' to be vented or pressurized. A filter 300' is positioned within the aperture 202' to trap unwanted particulate foreign matter.

Electrical pulses are supplied to the transducer 434' by means of two contact pins 422'. The pins 422' are inserted through respective apertures 419' of the housing section 402' and respective apertur s 421' of the housing section 403'. Two thin electrically conductive strips 410', 411', shown in Fig. 6b, are used to connect the transducer 434' with the contact pins 422'. A protective shield 405' extends from th housing position 403' to partially isolate the protruding portions of the contact pins 422'.

The function and operation of the jetting head 400' is similar to that of the jetting head 400 and therefore will not be discussed in detail. The collapsible inner lining 201' of the reservoir 200 allows the jetting tube 432' to be primed by pressurizing the reservoir 200' through the vent 205'. Once primed, the jetting head 400' may be used as described above in reference to the jetting head 400.

The jetting head 400' provides an advantage in that the entire fluidic system is contained in one housing. Such containment allows for fast and efficient replacement of the jetting heads without fluid contamination problems.

A third preferred embodiment of the jetting head is shown in Fig. 7 and generally represented as 400". The jetting head 400" comprises a housing 403", a reagent fluid supply tube 406", a piezo-electric transducer 434" and an orifice plate 404". The housing 403" defines a conically shaped fluid chamber 432". An orifice plate 404", defining an orifice 433", is fastened to the housing 403" such that the orifice 433" is located at or near the apex of the conical fluid chamber 432".

The fluid feed tube 406" is attached to the housing 403" and defines a supply channel 430". The supply channel 430" is in fluid communication with the fluid chamber 432" by means of a connecting channel 431". The base of the fluid chamber 432" is formed by the disc-shaped transduc r 434". The transducer 434" is

held in position by a hold down plate 402" attached to the housing 403". The electrical connec tions to the transducer 434" are of conventional design and are therefore not shown. The housing 403" further comprises a threaded aperture 406" for mounting the jetting head 400".

The jetting head 400" operates in a manner similar to the jetting heads described above. However, in this jetting head the transducer 434" is normally disk shaped. When the electrical pulse is applied, the transducer 434" bends slightly, thereby altering the volume of the conically shaped jetting chamber 432". The change in volume of the chamber 432" causes the expulsion of fluid through the orifice 433" and the intake of fluid through the supply channel 430" as described in reference to the jetting head 400.

A fourth preferred embodiment of the jetting head is shown in Fig. 8 and is generally represented as 400"" . The jetting head 400"" is very similar in form and function to the jetting head 400 and will not be described in detail. The jetting head 400"" comprises two symmetrical housing sections. The sections may be connected together by means of apertures 409"" and screws, not shown. When assembled, the housing sections 404"", 402"" form a T-shaped supply channel 410"" .

In operation, the jetting head 400"" functions in a manner similar to the jetting head 400. The jetting head 400"" is especially suited for use in the continuous mode, but may also be used in the drop on demand mode. In the continuous mode, the fluid is circulated continuously through the supply channel 430"" allowing the jetting tube 432"" to withdraw as much fluid as required.

By way of illustrating and with no limitations intended the following information is given to further illustrate the above described embodiments. The computer 700 is an IBM Corporation Personal Computer with 640 kbytes of RAM memory. The interface unit 600 is a Burr Brown interface unit model number PC 20001. The plotter 800 is manufactured by Houston Instrument as model number DMP-40. Communication between the plotter 800 and the interface unit 600 is performed through a standard asynchronous serial communication port.

The electrical pulse applied to the jetting head 400 to activate the transducer 434 comprises a rise time of approximately 5 usecs, a fall time of approximately 5 usecs and a pulse width of approximately 35 usecs. When the transducer 434 is operated in the drop on demand mode, the voltage potential of the pulse is 60 volts plus or minus 10 volts and the pulse frequency can be up to 4 khz. When the transducer 434 is operated in the continuous mode, the voltage potential of the pulse is 30 volts plus or minus 10 volts and the pulse frequency can be up to 10 khz.

The jetting tube 432 is manufactured from a pyrex glass tube and measures .027 inches outside diameter and .020 inches inside diameter. The tube is drawn to a closed taper in an electric furnace. The tapered end is then cut and ground to a desired orifice opening of .002 to .004 inches in diameter. The tube is cut to a final length of .945 inches in the case of the dispenser embodiment and ultrasonically cleaned in acetone. After being cleaned and dried the large end of the tube is fire polished. If desired, the orifice end of the tube may receive a coating, such as a hydrophobic polymer, to enhance droplet separation from the tube.

The supply tube 430 is formed from .023 inch inside diameter and .38 inch outside diameter polyethylene tubing produced by Intramedic Corp. as model number #14 170 11B. During assembly, one end of the tubing is stretched over a warm tapered mandrel. The stretched end of the supply tube 430 is then inserted over the large fire polished end of the jetting tube 432. The assembly is then cleaned and baked in a circulating air oven at 50°C. for 10 minutes.

The transducer 434 was purchased from Vernitron of Cleveland, Ohio as model number PZT-5H. The electrodes 437, 436 are comprised of nickel and are separated from each other on the outer surface of the transducer by approximately .030 inches. The jetting tube 432 is inserted into the cylindrical piezo-electric tube 434 and secured with epoxy manufactured by Epoxy Technology of Bellenca, Massachusetts as model number 301. The epoxy is applied at the junction of the tube 432 and transducer 434 with a syringe. The epoxy flows along the tube 432 inside the transducer 434 by capillary action. The assembly is then baked in a circulating air oven at 65°C. for one hour to cure the epoxy.

The contact pins 422 are secured to one of the housing sections 402, 404 with a drop of epoxy. The transducer jetting tube 434, 432 is placed in the housing such that the orifice end 433 of the tube 432 protrudes approximately .030 inches from the housing 403, 404. A drop of silver epoxy is placed between each contact pin 422 and the transducer 434 to ensure a secure electrical connection. Epoxy is also applied to the junction of the housing 402, 404 and supply tube 430. The other section of the housing 402, 404 is then screwed into place.

The periphery of the housing 402, 404 is sealed with a capillary sealer such as cyclohexanone. Epoxy is then added around each contact pin 422 and around the orifice end 433. The assembly is then baked in a circulating air oven at 65°C. for one hour.

The filter 300 is formed from a polyester mesh with 30 um pores and positioned in a polypropylene

housing. The air pressure supplied to the reservoir 200 during continuous printing operations is regulated at approximately 10 to 30 psi.

The reagents used have the following characteristics:

Printing (drop on demand mode):
Fluid viscosity range: 1 - 30 centipoises
Fluid surface tension: 20 - 70 dyne/cm
Printing (continuous mode):
Fluid viscosity range: up to 50 centipoises
Fluid surface tension: not measured
Dispensing (drop on demand mode):
Fluid viscosity range: 2 - 30 centipoises
Fluid surface tension: 20 - 70 dyne/cm

A measure of the performance and selected operating characteristics for a typical jetting head are presented in Figs. 9-11. Fig. 9 is a graph of the mass of a droplet as a function of droplet emission frequency for three fluids. The viscosity of the fluids were 1, 5 and 24 centipoise and the transducer excitation pulse width was 35 microseconds. As shown in Fig. 9, the higher fluid viscosity results in a more stable operating performance of the jetting head. Fig. 10 is a graph of droplet velocity as a function of droplet emission frequency for fluid viscosities of 1, 5 and 24 centipoise. The log of the total fluid weight as a function of the log of the number of droplets emitted is shown in Fig. 11. The fluid used has a viscosity of 2 centipoise, a surface tension of 20 dynes/cm, and a density of .8 grams/cc. The transducer excitation pulse was 80 volts and the excitation frequency was approximately 711 Hz.

Some blood typing reagents and some allergen reagents have very low viscosities and surface tensions. Although in some cases viscosity modifiers, such as glycerol, dextran, glucose, and the like, may be added to increase the viscosity, a few reagents are adversely affected by such modifiers.

Developing stable and reproduceable demand mode jetting is difficult with very low viscosities. Although droplet emission can be established at some fundamental frequencies, the droplets dispensed may have small satelite droplets which reduce the accuracy for metering and dispensing applications. However, even with the satelite drops, sufficient reagent is adequately delivered for most print applications without a substantial decrease in print quality.

Glycerin may be used as a viscosity modifier to improve jetting reliability and to prevent obstruction of the orifice arising from evaporation of the reagent fluid components. Glycerin has been found specially beneficial for those reagents containing particulate material. The evaporation of the fluid component results in a concentration of glycerin located at the orifice. The plug of glycerin substantially prevents further evaporation of the reagent fluid. During the next activation cycle of the transducer, the plug of glycerin is expelled from the orifice.

When operating in the dispensing mode the volume of the droplets can be varied to substantially uniformly contain from 100 pico-liters to 1 micro-liter. The droplets can be produced at a rate of approximately 1 khz to 8 khz. When operating in the printing mode the size of the pel made by each droplet measures approximately .001-.012 inches in diameter.

A copy of the program used in the computer 700 for a printing operation is attached hereto as Appendix A. The values, manufacturer and manufacturing part number of the circuit components of the jetting control unit 500 are substantially as follows:

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
R39,45-48,57, 58	RES.10KOHM¼WATT5%C.F.	
R66	RES.150OHM¼WATT5%C.F.	
R3	RES.15KOHM¼WATT5%C.F.	
R34	RES.16KOHM¼WATT5%C.F.	
R50	RES.2.4KOHM¼WATT1%M.F.	DALE RL079242G
R13,23,36,40, 41	RES.2.4KOHM¼WATT5%C.F.	
R56	RES.20KOHM¼WATT5%C.F.	
R8	RES.220OHM¼WATT5%C.F.	
R6	RES.270HM1WATT5%C.C.	
R7,12,25	RES.2KOHM¼WATT5%C.F.	
R67	RES3.6KOHM¼WATT5%C.F.	
R51,53	RES.3.9KOHM¼WATT5%C.F.	
R29	RES.300KOHM¼WATT5%C.F.	
R61	RES.30KOHM¼WATT1%M.F.	DALE RL079303G
R15-18,26-28, 54,55,64	RES.4.7KOHM¼WATT5%C.F.	
R62	RES.45.3KOHM¼WATT1%M.F.	DALE RN55D4532F
R30,33	RES.470HM¼WATT5%C.F.	
R21	RES.4700HM¼WATT5%C.F.	
R19	RES.47KOHM¼WATT5%C.F.	
R35	RES.5100HM¼WATT5%C.F.	
R43	RES.6.2KOHM¼WATT5%C.F.	
R60	RES.7.5KOHM¼WATT5%C.F.	
R37	RES.75KOHM¼WATT5%C.F.	
R9	RES.76KOHM¼WATT1%M.F.	DALE RN60D7682F
R11	RES.8200HM¼WATT5%C.F.	
U2,11,14,16,22	RES.DIP NETWRK.47KOHM	CT9 761-1R47K
C21,41,45	CAP.AXIALIMF@250VDC	MALLORY #TC56
C24	CAP.AXIAL220MF@250VDC	MALLORY LF2219250C7P3
C10	CAP.AXIAL ALUM ELEC. 4700 OMF@25VDC	MALLORY TCG472J025NIC
C1,2,3,55,60	CAP.RADIAL DIPPED TANT. 10MF@25VDC	KEMET T350E106M025AS
C53	CAP.RADIAL DIPPED TANT. 1MF@35VDC	KEMET T350A105K035AS
C36	CAP.RADIAL DIPPED TANT. 47MF@10VDC	KEMET T350E566MC10AS

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
C54	CAP.RADIAL SILV MICA 100PF300VDC	KAHGAN SD5101J301
C57	CAP.RADIAL SILV MICA 20PF300VDC	KAHGAN SP12200J301
C49	CAP. RADIAL SILV. MICA 39PF300VDC	KAHGAN SP12390J301
C39	CAP.RADIAL X7R MLC .015MF@50VDC	KEMET C315C102K1R5CA
C6	CAP.RADIAL X7R MLC .022MF@50VDC	KEMET C315C223K5R5CA
C30,35,37	CAP.RADIAL Z5U MLC .015MF@50VDC	KEMET C315C153K5R5CA
C4,7	CAP.RADIAL Z5U MLC .01MF@50VDC	KEMET C315C103K5R5CA
C4,5,6,9,11-19, 22,23,25-28 C31-34,37,42,43 47,48,50-52 C56,58,59	CAP.RADIAL Z5U MLC .22MF@50VDC	KEMET C322C224M5U5CA
C46	CAP.VARI.2-12PF.	JOHANSEN #9626
CR7,8,9,10, 11,12,17	DIODE SIL.	ITT.FAIRCHLD.1N4148
CR1,2,3,4	DIODE SIL.FAST	GENL.INST.EGP10D
CR5	DIODE SIL.FASTHIVOLT	GENL.INST.UF4007
CR6,13,15	DIODE SIL.REF.2,500VDC	NATL.SEMI-LM3852-2.5
CR14,16	DIODE SIL.ZENER3.3V.25WATT	MOTOROLA 1N4622A
U6,13,15,17	SWITCH 8 POSITION DIP	CTS 206-8
Q2,9,12	TRANSTOR.COMMON NPN	MOTOROLA 2N2222A
Q8,10,11	TRANSTOR.COMMON PNP	MOTOROLA 2N2907A
Q4	TRANSTOR.HIVOLTHIFREQ.NPN	MOTOROLA MPSU10
Q7	TRANSTOR.HIVOLTHIFREQ.PNP	MOTOROLA MPSU60
Q1	TRANSTOR.HIVOLTHIINPN	TI,MOTOROLATIP48
Q3,14	TRANSTOR.HIVOLTNPN2N3439	MOTOROLA 2N3439
Q13	TRANSTOR.HIVOLTPNP	MOTOROLA MJE5731
U5,27	IC 1-SHOT 74HC221	NATL.SEMI MM74HC22IN
U23,26	IC 1-SHOT 74LS221	NATL.SEMI DM741S221N
U7-10	IC COMPARATOR 74HC688	NATL.SEMI MM74HC688N
U30	IC CONVERTER DAC0800	NATL.SEMI DAC0800LCN
U24,25	IC COUNTER 74HC193	NATL.SEMI MM74HC193N
U28	IC HI SLEW HI VOLT OP AMP	BURR-BROWN 3584JM
U1	IC HYBRID DC/DC CONVERTER	BURR-BROWN MODEL 724
U4	IC OC DRIVER SN7406	NATL.SEMI DM7406N
U3	IC OCTAL LATCH 74HC374	NATL. MM74HC374N
U12,29,31,32	IC OP AMP LF256	NATL.SEMI LF256H
U18,19,20,21	IC OPTO ISOLATOR	HEWLTT-PCKRD HCPL2300
R24,42,63	POT100KOHM½WATT10%	BOURNS 3622-1-104
R38,49,52	POT10KOHM½WATT10%	BOURNS 3622W-1-103
R20	POT25KOHM½WATT10%	BOURNS 3622W-1-253
R14,31	POT2KOHM½WATT10%	BOURNS 3622W-1-202

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
VRI	REGULATOR 5VDC	NATL.LM340T-5.0
R10	RES.1MEGOHM¼WATT5%C.F.	
R2,4	RES.1.2KOHM¼WATT5%C.F.	
R32	RES.1.6KOHM¼WATT5%C.F.	
R44	RES.1.8KOHM¼WATT5%C.F.	
R1	RES.10MEGOHM¼WATT5%C.F.	
R5,R22	RES.100HM¼WATT5%C.F.	
R65	RES.100KOHM¼WATT5%C.F.	
R59	RES.10KOHM¼WATT1%M.F.	DALE RN55D1002F
R100	RES.270OHM	
R101,108	RES.470OHM	
R102,103 106,109,110	RES.1KOHM	
R104	RES.4700OHM	
R105	POT.100KOHM	
R107	POT.10KOHM	
R111,113	RES.2200HM	
R112	RES.22OHM	
R114,115	RES. 47OHM	
C100	CAP.10MF035 VPC	
C108	CAP.10000 PF	
D100	DIODE	1N4148
Q100,105	TRANSTOR	2N2222
Q101,102	TRANSTOR	2N3906
Q103,104	TRANSTOR	2N3904
U100,U108	IC I-SHOT	74LS123
U103,104 105,106	IC INVERTOR	74LS04
U108	IC LINE DECODER	74LS138

Of course, it should be understood that a wide range of changes and modifications can be made to the preferred embodiments described above. For example, the transducer could be of a type other than piezo-electric such as magneto-strictive, electro-strictive, and electro-mechanical. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.

APPENDIX

```
Offset  Data   Source Line

0030  0006  REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Reagent Calibration' $LINESIZE: 132
0030  0006  'MODULE   - "REAGAL"
0030  0006  '
0030  0006  'AUTHOR   - M. A. Enevold
0030  0006  '
0030  0006  'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030  0006  'REVISION - 2.0 07-01-86 MAE MicroFab modifications
0030  0006  '         - 1.0 02-11-86 MAE Creation of initial code
0030  0006  '
0030  0006  'SYSTEM   - This code can only be compiled by the BASCOM
0030  0006  '           COMPILER, it will not run under the INTERPRETER!!
0030  0006  '
0030  0006  'DESCRIPTION:
0030  0006  '       The reagent calibrate module presents a menu with 12 items arranged
0030  0006  '       in 3 columns of 4 rows.  The arrow keys allow movement around the
0030  0006  '       table, the + and - keys increment or decrement values in the first
0030  0006  '       column, and the enter key executes commands in the third column.
0030  0006  '       The second column is an array of ASCII strings representing reagent name,
0030  0006  '       concentration, density, and viscosity.  The values entered in column one
0030  0006  '       are drop frequency, pulse width, strobe delay, and nozzle number.
0030  0006  '       The commands in the third column are start/stop, load, save, and exit.
0030  0006  '
0030  0006  'DATA DICTIONARY
0030  0006  '       MENUI         Pointer to which menu item is active (0-11)
0030  0006  '       MENUS(17,1)   Array for strings used to display the menu
0030  0006  '       MENU(17,4)    Array for numbers in the menu display
0030  0006  '       DIFFI         Differential to move MENUI at arrow key input
0030  0006  '       TYPEI         Pointer set during main scan to direct action
0030  0006  '       KEYBUF$       Storage for string input from menu display
0030  0006  '       A$            Destination for single keystroke inputs
0030  0006  '       FILE$         String where filename is built for reagent data file
0030  0006  '       REANAME$      String where reagent name is stored
0030  0006  '       RI            Row to display special graphics character in menu
0030  0006  '       CI            Column to display special graphics character in menu
0030  0006  '       MI            Special graphics character is read into here
0030  0006  '       OLD.AMP.VALUEI Integer value for setting pulse amplitude
0030  0006  '       BIG.VAL1      Value set to digital port 0 to inc/dec amplitude
0030  0006  '
0030  0006  SUB REAGENT.CALIBRATE STATIC
0047  0006
0047  0006          DIM MENUS(17,1),MENU(17,4)
0048  01FE
0048  01FE          GOSUB INITIALIZE:       'read init. values and set screen
004E  01FE
004E  01FE          WHILE TYPEI <> 1
0051  0200
0051  0200            TYPEI = 0
0060  0200            A$ = ""
006A  0204
006A  0204            WHILE A$ = ""
0079  0204              A$ = INKEY$
0083  0204              IF ACTIVEI = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
00A0  0204            WEND
00B0  020A
```

Reagent Jet Printer
Reagent Calibration

```
Offset  Data    Source Line

0080    020A            IF A$ = CHR$(13) THEN TYPE% = 1:                'execute (cr)
00CA    020A            IF A$ = "+" THEN TYPE% = 2:                     'increment variable
00E0    020A            IF A$ = "-" THEN TYPE% = 3:                     'decrement variable
00F6    020A            IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 4:      'up arrow key
011B    020A            IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 5:      'down arrow key
0140    020A            IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 6:      'left arrow key
0165    020A            IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 7:      'right arrow key
018A    020A            IF A$ > CHR$(47) AND A$ < CHR$(123) THEN TYPE% = 8:' ascii 0 - z
01C2    020A
01C2    020A            ON TYPE% GOSUB T1, T2, T3, T4, T5, T6, T7, T8
01DB    020A
01DB    020A          WEND
01DF    020A          TYPE% = 0
01E6    020A
01E6    020A          EXIT SUB
01EA    020A    REM $PAGE
```

```
Offset  Data   Source Line

01EA    020A   '********** SUBROUTINES FOR THIS MODULE **********
01EA    020A
01EA    020A   T1:             '(cr) execute command
01EF    020A           IF MENU% < 12 THEN TYPE% = 0:RETURN:    'exit to print menu, no action
0205    020C           ON MENU% - 11 GOSUB T1A, T1B, T1C, T1D
021A    020C           IF MENU% < 15 THEN TYPE% = 0
022C    020C           RETURN
0230    020C
0230    020C   T1A:            'start/stop drop flow
0235    020C           IF MENU$(12,0) = "START" THEN GOSUB START.INX
025A    020C           IF MENU$(12,0) = "STOP " THEN GOSUB STOP.INX
027F    020C           MENU$(12,0) = TEMP$
029A    0210           COLOR 0,7:GOSUB DISPMENU
02AC    0210           RETURN
02B0    0210
02B0    0210   START.INX:
02B5    0210           TEMP$ = "STOP "
02BF    0210           CALL DOT.ON:            'in module PC1
02C8    0210           LOCATE 17,71:COLOR 27,0:PRINT "PRINTING";
02F1    0210           ACTIVE% = 1
02F8    0210           RETURN
02FC    0210
02FC    0210   STOP.INX:
0301    0210           TEMP$ = "START"
0308    0210           CALL DOT.OFF:           'in module PC1
0317    0210           LOCATE 17,71:COLOR 15,0:PRINT "       ";
0338    0210           ACTIVE% = 0
0344    0210           RETURN
0346    0210
0348    0210   T1B:            'load reagent profile
0349    0210           IF MENU$(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
0391    0210
0391    0210           GOSUB SEARCH
0397    0210
0397    0210           IF I% < (REAMAX% + 1) THEN GOTO FOUND
03A8    0214           LOCATE 25,10-LEN(MENU$(6,1))/2:PRINT MENU$(6,1);" not Found";
0404    0214           GOSUB ANYKEY:   'wait for a keyhit
0404    0214           RETURN
040E    0214
040E    0214   FOUND:
0413    0214           FILE$ = RIGHT$(STR$(I%),LEN(STR$(I%))-1) + "REA.RJP"
0437    0218           OPEN FILE$ FOR INPUT AS #1:     'set pattern data file for read
0448    0218           INPUT #1,MENU(0,0):     'read frequency
0468    0218           INPUT #1,MENU(1,0):     'read amplitude
0488    0218           INPUT #1,MENU(2,0):     'read strobe delay
04AE    0218           INPUT #1,MENU(3,0):     'read pulse width
04D1    0218           INPUT #1,MENU(4,0):     'read rise time
04F4    0218           INPUT #1,MENU(5,0):     'read fall time
0519    0218
0519    0218           INPUT #1,MENU$(7,1):    'read concentration
0530    0218           INPUT #1,MENU$(8,1):    'read density
0561    0218           INPUT #1,MENU$(9,1):    'read viscosity
0585    0218           INPUT #1,MENU$(10,1):   'read surface tension
05A7    0218
```

5 Reagent Jet Printer
Reagent Calibration

```
  Offset  Data    Source Line

    0549  0218          CLOSE #1:       'done with data file
10  0580  0218
    0580  0218          OPEN "READEF.RJP" FOR OUTPUT AS #1
    0582  0218          PRINT #1,FILE$:                 'save filename in default file
    05C2  0218          PRINT #1,MENU$(6,1):    'save the directory name as well
    05D2  0218          CLOSE #1
    05F4  0218          GOSUB DISP.PARMS:       'show all parameters
    05FB  0218          RETURN
15  0601  0218
    0603  0218
    0603  0218  T1C:           'save reagent profile
    060A  0218          IF MENU$(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
    064E  0218          OPEN "READIR.RJP" FOR INPUT AS #1
    065F  0218          INPUT #1,REANUM1
20  0671  0218          CLOSE #1
    0678  0218          IF REANUM1 < 80 THEN GOTO SAVE.REA
    0687  0218          LOCATE 25,1:PRINT "Directory is Full (80 reagents max.)"
    06A1  0218          GOSUB ANYKEY:RETURN
    06AB  0218  SAVE.REA:
    06B0  0218          GOSUB SEARCH
25  0686  0218          IF I% > REANUM1 THEN GOTO SAVEREA1
    06C7  0218          REANUM1 = I%
    06CE  0218          COLOR 15,0
    06DA  0218          LOCATE 25,1:PRINT MENU$(6,1);" already exists. Replace it with new values? ";
    070C  0218          A$ = ""
    0716  0218          WHILE A$ = ""
30  0725  0218                A$ = INKEY$
    072F  0218          WEND
    0732  0218          LOCATE 25,1:PRINT SPACE$(79);
    074F  0218          IF A$ = "Y" OR A$ = "y" THEN GOTO REPLACE
    0778  0218          RETURN
    077C  0218
35  077C  0218  SAVEREA1:
    0781  0218          KILL "READIR.OLD":      'delete old backup directory
    0788  0218          NAME "READIR.RJP" AS "READIR.OLD":      'save old directory
    0792  0218          OPEN "READIR.OLD" FOR INPUT AS #1
    07A3  0218          OPEN "READIR.RJP" FOR OUTPUT AS #2:     'set up new dir
    07B5  0218
40  07B5  0218          INPUT #1,REANUM1:       'read number of dir entries
    07C7  0218          REANUM1 = REANUM1 + 1:  'increase by 1
    07D0  0218          WRITE #2,REANUM1:       'save in new directory
    07E1  0218
    07E1  0218          FOR I=1 TO REANUM1 - 1
45  07FA  021C              LINE INPUT #1,A$:   'read entry from old dir
    0807  021C              PRINT #2,A$:        'write entry in new directory
    0817  021C          NEXT I
    0832  0220
    0832  0220          CLOSE #1
    0839  0220
    0839  0220          PRINT #2,MENU$(6,1):    'write new entry to new directory
50  0858  0220          CLOSE #2:       'done with directory
    0862  0220
    0862  0220  REPLACE:
    0867  0220          FILE$ = RIGHT$(STR$(REANUM1),LEN(STR$(REANUM1))-1) + "REA.RJP"
    0888  0220
55
```

```
5
  Reagent Jet Printer                                                                    PAGE  5
  Reagent Calibration                                                                    07-14-86
                                                                                         12:26:57
  Offset  Data    Source Line                                  IBM Personal Computer BASIC Compiler V2.00

10 0888   0220          OPEN FILE$ FOR OUTPUT AS #1:    'create new pattern data file
   0890   0220          WRITE #1,MENU(0,0):     'store frequency
   0898   0220          WRITE #1,MENU(1,0):     'store amplitude
   08DC   0220          WRITE #1,MENU(2,0):     'store strobe delay
   08FD   0220          WRITE #1,MENU(3,0):     'store pulse width
   091E   0220          WRITE #1,MENU(4,0):     'store rise time
15 093F   0220          WRITE #1,MENU(5,0):     'store fall time
   0962   0220
   0962   0220          WRITE #1,MENUS(7,1):    'store concentration
   0984   0220          WRITE #1,MENUS(8,1):    'store density
   09A6   0220          WRITE #1,MENUS(9,1):    'store viscosity
   09C8   0220          WRITE #1,MENUS(10,1):   'store surface tension
20 09EA   0220
   09EA   0220          CLOSE #1:       'done with data file
   09F1   0220
   09F1   0220          OPEN "READEF.RJP" FOR OUTPUT AS #1
   0A03   0220          PRINT #1,FILE$:                 'save filename in default file
   0A13   0220          PRINT #1,MENUS(4,1):    'save the directory name as well
25 0A35   0220          CLOSE #1
   0A3C   0220          RETURN
   0A40   0220
   0A40   0220    SEARCH:
   0A45   0220          OPEN "READIR.RJP" FOR INPUT AS #1
   0A56   0220          INPUT #1,REANUMI:       'read number of patterns in dir
30 0A68   0220          I% = 1:                         'set entry pointer
   0A6F   0220
   0A6F   0220    SLOOP:
   0A74   0220          LINE INPUT #1,A$:       'read next pattern name from dir
   0A81   0220          IF A$ = MENUS(6,1) THEN GOTO SEARCH.DONE:       'compare name with dir entry
   0AA5   0220          I% = I% + 1
35 0AAE   0220          IF I% < (REANUMI + 1) THEN GOTO SLOOP:'check for done
   0AC1   0220    SEARCH.DONE:
   0AC6   0220          CLOSE #1
   0AC8   0220          RETURN
   0AD1   0220
   0AD1   0220    TI0:            'return with no change to exit reagent calibrate
40 0AD6   0220          PRINT #3,"UH";
   0AE6   0220          CLOSE #3:'      close com channel
   0AE8   0220          RETURN
   0AF1   0220
   0AF1   0220    T2:             'process "+" key
   0AF6   0220          IF MENUI > 5 THEN RETURN
45 0B05   0220          NEWTIME = TIMER
   0B0F   0224          DELTATIME = NEWTIME - OLDTIME
   0B1F   022C          OLDTIME = NEWTIME
   0B21   022C          IF DELTATIME > 0.15 THEN MULTI = 1 ELSE MULTI = MULTI + 1
   0B48   022E          IF MULTI > 100 THEN MULTI = 100
50 0B58   022E          MENU(MENUI,0) = MENU(MENUI,0) + MENU(MENUI,3) * MULTI:  'add increment
   0B9F   022E          IF MENU(MENUI,0) > MENU(MENUI,1) THEN MENU(MENUI,0) = MENU(MENUI,1):    'check max value
   0C06   022E          COLOR 15,1:GOSUB DISPMENU:RETURN:                       'show new value
   0C1B   022E
   0C1B   022E    T3:             'process "-" key
   0C22   022E          IF MENUI > 5 THEN RETURN
55 0C31   022E          NEWTIME = TIMER
```

```
 Offset  Data   Source Line

0C3B   0ZZE          DELTATIME = NEWTIME - OLDTIME
0C48   0ZZE          OLDTIME = NEWTIME
0C55   0ZZE          IF DELTATIME ) 0.15 THEN MULTI = 1 ELSE MULTI = MULTI + 1
0C77   0ZZE          IF MULTI ) 100 THEN MULTI = 100
0C89   0ZZE          MENU(MENUI,0) = MENU(MENUI,0) - MENU(MENUI,3) * MULTI:  'sub increment
0CCB   0ZZE          IF MENU(MENUI,0) ( MENU(MENUI,2) THEN MENU(MENUI,0) = MENU(MENUI,2):    'check min value
0CD2   0ZZE          COLOR 15,1:GOSUB DISPMENU:RETURN:                       'show new value
0D49   0ZZE
0D49   0ZZE   T4:            'process up arrow key
0D4E   0ZZE          IF MENUI MOD 6 = 0 THEN RETURN:              'in top row already
0D63   0ZZE          DIFFI = -1:GOSUB NEWMENU:RETURN:        'move pointer up one
0D74   0Z30
0D74   0Z30   T5:            'process down arrow key
0D79   0Z30          IF MENUI MOD 6 = 5 THEN RETURN:              'in bottom row already
0D8F   0Z30          DIFFI = 1:GOSUB NEWMENU:RETURN:              'move pointer down one
0DA0   0Z30
0DA0   0Z30   T6:            'process left arrow key
0DA5   0Z30          IF INT(MENUI / 6) = 0 THEN RETURN       'in left column already
0DC5   0Z30          DIFFI = -6:GOSUB NEWMENU:RETURN:        'move pointer one left
0DD6   0Z30
0DD6   0Z30   T7:            'process right arrow key
0DDB   0Z30          IF INT(MENUI / 6) = 2 THEN RETURN       'in right column already
0DFE   0Z30          DIFFI = 6:GOSUB NEWMENU:RETURN:              'move pointer one right
0E0F   0Z30
0E0F   0Z30   T8:            'input keys into KEYBUF$ until (cr) is entered
0E14   0Z30          IF MENUI ) 10 THEN RETURN
0E23   0Z30          LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0E35   0Z30          KEYBUF$ = A$
0E5F   0Z34          WHILE A$ <> CHR$(13)
0E72   0Z34                 LOCATE 25,47:PRINT SPACE$(15);
0E8F   0Z34                 LOCATE 25,47:PRINT KEYBUF$;
0EA9   0Z34                 A$ = ""
0EB3   0Z34                 WHILE A$ = ""
0EC2   0Z34                       A$ = INKEY$
0ECC   0Z34                       IF ACTIVE1 = 1 AND DOWNTIME ( TIMER THEN GOSUB PEN.DOWN
0EF6   0Z34                 WEND
0EF9   0Z34                 IF A$ = CHR$(8) AND LEN(KEYBUF$) ) 0 THEN KEYBUF$ = LEFT$(KEYBUF$,LEN(KEYBUF$)-1)
0F3B   0Z34                 IF A$ ) CHR$(31) AND LEN(KEYBUF$) ( 15 THEN KEYBUF$ = KEYBUF$ + A$
0F75   0Z34          WEND
0F79   0Z34
0F79   0Z34          IF MENUI ) 5 THEN GOTO STORESTRING
0F88   0Z34
0F88   0Z34          TEMP = VAL(KEYBUF$)     'temp has value of keys input
0F98   0Z38
0F98   0Z38          'round off temp according to step size in menu array
0F98   0Z38          TEMP = INT(TEMP / (MENU(MENUI,3)) + .5) * MENU(MENUI,3)
0F81   0Z38
0F81   0Z38          'test TEMP for maximum and minimum values in menu array
0F81   0Z38          IF TEMP ) MENU(MENUI,1) THEN TEMP = MENU(MENUI,1)
1019   0Z38          IF TEMP ( MENU(MENUI,2) THEN TEMP = MENU(MENUI,2)
104F   0Z38
104F   0Z38          'insert new value into menu array and update screen
104F   0Z38          MENU(MENUI,0) = TEMP
1068   0Z38          LOCATE 25,30:PRINT SPACE$(40);
```

```
  Offset  Data    Source Line

1068  023B          COLOR 0,7:GOSUB DISPMENU
106A  023B          RETURN
106E  023B
106E  023B    STORESTRING:
10A3  023B          MENUS(MENUZ,I) = KEYBUF$
10BF  023B          LOCATE 25,30:PRINT SPACE$(40);
10DC  023B          COLOR 0,7:GOSUB DISPMENU
10EE  023B          RETURN
10F2  023B
10F2  023B    PEN.DOWN:
10F7  023B          DOWNTIME = TIMER + 1
1107  023B          PRINT #3,"D";
1117  023B          RETURN
1118  023B
1118  023B    ANYKEY:
1120  023B          LOCATE 25,44:PRINT "Strike any key..";
113A  023B          A$ = ""
1144  023B          WHILE A$ = ""
1153  023B                A$ = INKEY$
1150  023B          WEND
1160  023B          LOCATE 25,1:COLOR 15,0:PRINT SPACE$(79);:COLOR 15,1
1196  023B          RETURN
119A  023B
119A  023B    NEWMENU: 'write old item in yellow, point to and highlight new item
119F  023B          COLOR 14,0:GOSUB DISPMENU
1181  023B          MENUZ = MENUZ + DIFFZ
1180  023B          IF MENUZ < 11 THEN MENUZ = 10
11CF  023B          IF MENUZ > 15 THEN MENUZ = 15
11E1  023B          COLOR 0,7:GOSUB DISPMENU:RETURN
11F7  023B
11F7  023B    INITIALIZE:
11FC  023B          'change to second screen and display messages
11FC  023B          SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,28:PRINT "Initializing Menu Display";
1240  023B          LOCATE 12,33:PRINT "Please wait..."
125A  023B
125A  023B          'initialize variables
125A  023B
125A  023B          ACTIVEZ = 0:'  not printing
1261  023B
1261  023B          'initialize plotter com channel
1261  023B
1261  023B          OPEN "COM1:2400,N,8,2" AS #3
1273  023B          PRINT #3,"I";:UEC$,EFV1,M";
1283  023B
1283  023B          'initialize digital port
1283  023B          SCRZ = 4
1288  023A          CALL DIGITAL.OUT(SCRZ)
129A  023A          SCRZ = 0
12A1  023A          CALL DIGITAL.OUT(SCRZ):        'pulse reset line to set amplitude to 0V.
12B1  023A          SCRZ = 4
12B8  023A          CALL DIGITAL.OUT(SCRZ)
12C8  023A
12C8  023A          'set hardware pulse width
12C8  023A          CALL SET.DOT.WIDTH(5)   'in module PCI
```

```
5                                                                                                   PAGE   8
Reagent Jet Printer                                                                                 07-14-86
Reagent Calibration                                                                                 12:26:57
                                                                                    IBM Personal Computer BASIC Compiler V2.00
 Offset- Data    Source Line

10 120E  023C
   120E  023C          'initialize menu arrays
   120E  023C          RESTORE ARRDATA
   120E  023C          FOR IX=0 TO 17
   12E3  023C                READ MENUS(IX,0),MENUS(IX,1)
   12E8  023C                READ MENU(IX,1),MENU(IX,2),MENU(IX,3),MENU(IX,4)
   1318  023C          NEXT IX
15 137C  023C
   138F  023C          'set default reagent values
   138F  023C
   138F  023C          MENU(0,0) = 2000:               'frequency
   138F  023C          MENU(1,0) = 0:                  'amplitude
   12A8  023C          MENU(2,0) = 1:                  'strobe delay
20 13C4  023C          MENU(3,0) = 090:                'pulse width
   13E0  023C          MENU(4,0) = 470:                'rise time
   13FC  023C          MENU(5,0) = 070:                'fall time
   1418  023C
   1436  023C          MENU(6,0) = 0:                  'name
   1436  023C          MENU(7,0) = 0:                  'concentration
25 1452  023C          MENU(8,0) = 0:                  'density
   146E  023C          MENU(9,0) = 0:                  'viscosity
   148A  023C          MENU(10,0) = 0:                       'surface tension
   14A6  023C
   14C2  023C          OLD.AMP.VALUE% = 0              'initial value of 0 volts
   14C2  023C
30 14C9  023E
   14C9  023E          'change active displayed screen to first screen to draw and display parameters
   14C9  023E
   14C9  023E          SCREEN 0,0,0,1:CLS
   14E6  023E
   14E6  023E          COLOR 13:LOCATE 1,32:PRINT "REAGENT CALIBRATE";
35 1507  023E          COLOR 9
   150E  023E          FOR I=2 TO 79
   1518  023E                LOCATE 3,I:PRINT "D";:LOCATE 5,I:PRINT "D";:LOCATE 19,I:PRINT "D";
   154F  023E          NEXT I
   1588  023E          FOR I=4 TO 18
   1594  023E                LOCATE I,1:PRINT "3";:LOCATE I,28:PRINT "³";:LOCATE I,69:PRINT "³";:LOCATE I,80:PRINT "3";
40 1608  023E          NEXT I
   1626  023E          RESTORE TABLE
   1629  023E          FOR I=1 TO 12
   1637  023E                READ RI,CI,KI:LOCATE RI,CI:PRINT CHR$(KI);
   166A  0244          NEXT I
   1685  0244
45 1685  0244          'print three headings and instructions
   1685  0244          COLOR 10,0
   1691  0244          LOCATE 4,7:PRINT "DROP PARAMETERS";
   16A8  0244          LOCATE 4,39:PRINT "REAGENT PARAMETERS"
   16C5  0244          LOCATE 4,71:PRINT "COMMANDS";
   16DF  0244
50 16DF  0244          COLOR 7:LOCATE 21,20:PRINT "Use ";:COLOR 15:PRINT CHR$(27);CHR$(32);CHR$(26);
   1729  0244          PRINT CHR$(32);CHR$(24);CHR$(32);CHR$(25);:COLOR 7:PRINT " to position highlighted cursor";
   1768  0244          LOCATE 22,18:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
   178E  0244          COLOR 7:PRINT" to scroll current value up or down";
   17D2  0244          LOCATE 23,26:PRINT "Use ";:COLOR 15:PRINT "ENT";:COLOR 7:PRINT" to activate selection";
55 1814  0244
```

Reagent Jet Printer
Reagent Calibration

```
Offset  Data    Source Line

 1814   0244    DISP.PARMS:
 1819   0244            'display 12 menu choices in yellow
 1819   0244
 1819   0244            COLOR 14,0
 1825   0244            FOR MENUZ = 0 TO 17
 1823   0244                    GOSUB DISPMENU
 1831   0244            NEXT MENUZ
 1841   0244
 1841   0244            'set for reagent name and highlight it
 1841   0244            MENUZ = 6:COLOR 0,7
 1854   0244            GOSUB DISPMENU
 185A   0244
 185A   0244            SCREEN 0,0,0,0
 186F   0244            RETURN
 1873   0244    REM $PAGE
```

```
Offset  Data   Source Line

1873    0244   DISPMENU:
1878    0244          LOCATE (MENUI MOD 6)*2+7,(INT(MENUI/6)*28+2)+(5*INT(MENUI/12)
1804    0244          PRINT MENUS(MENUI,0)
18F2    0244          IF MENUI > 5 THEN GOTO SHOWSTRING:'     no value to display
1901    0244          LOCATE (MENUI MOD 6)*2+7,MENU(MENUI,4)
1933    0244          PRINT USING MENUS(MENUI,1);MENU(MENUI,0);
1966    0244          IF MENUI > 2 THEN RETURN
1975    0244          ON MENUI+1 GOSUB SET.FREQ, SET.AMP, SET.DELAY
1986    0244          RETURN
198A    0244   SHOWSTRING:
198F    0244          IF MENUI > 10 THEN RETURN
199E    0244          LOCATE (MENUI MOD 6)*2+7,48
19A8    0244          PRINT "          "
19C7    0244          LOCATE (MENUI MOD 6)*2+7,48
19E3    0244          PRINT MENUS(MENUI,1)
1A02    0244          RETURN
1A06    0244
1A06    0244   SET.FREQ:
1A08    0244          TEMP = MENU(0,0)
1A24    0244          CALL SET.DOT.RATE(TEMP):        'in module PCI
1A34    0244          LEDI = 3-INT((TEMP+500)/1000)
1A57    0246          IF LEDI < 0 THEN LEDI = 0
1A69    0246          SCRI = 4 + (LEDI * 32):                 'set LED intensity
1A89    0246          CALL DIGITAL.OUT(SCRI):                 'in module PCI
1A99    0246          RETURN
1A90    0246
1A90    0246   SET.AMP:
1AA2    0246          SCRI = CINT(MENU(MENUI,3) * 255 / 150):         'convert volts to binary number
1AC8    0246          IF SCRI = OLD.AMP.VALUE% THEN RETURN
1ADC    0246          TEMP% = SCRI - OLD.AMP.VALUE%:          'calculate delta
1AE8    0248          OLD.AMP.VALUE% = SCRI:                  'update old value to current value
1AEF    0248          DIG.VAL% = 6
1AF6    024A          IF TEMP% < 0 THEN DIG.VAL% = 5
1B08    024A          TEMP% = ABS(TEMP%)
1B15    024A          FOR I% = 1 TO TEMP%
1B22    024C                SCRI = DIG.VAL% + (32*LEDI)
1B3F    024C                CALL DIGITAL.OUT(SCRI):                 'pulse higher or lower
1B4F    024C                SCRI = 4 + (32 * LEDI)
1B6F    024C                CALL DIGITAL.OUT(SCRI):                 'set port to normal
1B7F    024C          NEXT I%
1B91    024C          RETURN
1B95    024C
1B95    024C   SET.DELAY:
1B9A    024C          TEMP = MENU(2,0)
1BB6    024C          CALL SET.STROBE.DELAY(TEMP):    'in module PCI
1BC6    024C          RETURN
1BCA    024C
1BCA    024C   REM $PAGE
```

Reagent Jet Printer
Reagent Calibration

```
 Offset  Data    Source Line

  18CA   024C    '************ DATA USED BY THIS MODULE ************

  18CA   024C
  18CA   024C    ARRDATA:
  18CA   024C            DATA "Frequency              Hz",**,***,***,10000,1,1,16
  18CF   024C            DATA "Amplitude              V ",***,***,150,0,1,19
  18D1   024C            DATA "Strobe Delay           uS",**,***,***.*,15999.5,.5,.5,16
  18D3   024C            DATA "Pulse Width              ",***,***,999,0,1,19
  18D5   024C            DATA "Rise Time                ",***,***,999,0,1,19
  18D7   024C            DATA "Fall Time                ",***,***,999,0,1,19
  18D9   024C            DATA "Name",**,0,0,0,0
  18DB   024C            DATA "Concentration",**,0,0,0,0
  18DD   024C            DATA "Density",**,0,0,0,0
  18DF   024C            DATA "Viscosity",**,0,0,0,0
  18E1   024C            DATA "Surface Tension",**,0,0,0,0
  18E3   024C            DATA **,**,0,0,0,0
  18E5   024C            DATA "START",**,0,0,0,0
  18E7   024C            DATA "LOAD",**,0,0,0,0
  18E9   024C            DATA "SAVE",**,0,0,0,0
  18EB   024C            DATA "EXIT",**,0,0,0,0
  18ED   024C            DATA **,**,0,0,0,0
  18EF   024C            DATA **,**,0,0,0,0
  18F1   024C
  18F3   024C    TABLE:
  18F3   024C            DATA 3,1,218
  18F8   024C            DATA 3,28,210
  18FA   024C            DATA 3,69,210
  18FC   024C            DATA 3,80,191
  18FE   024C            DATA 5,1,198
  1C00   024C            DATA 5,28,206
  1C02   024C            DATA 5,69,206
  1C04   024C            DATA 5,80,181
  1C06   024C            DATA 19,1,192
  1C08   024C            DATA 19,28,208
  1C0A   024C            DATA 19,69,208
  1C0C   024C            DATA 19,80,217
  1C0E   024C
  1C10   024C
  1C10   024C    END SUB
  1C17   024C
  1C17   024C
  23EB-  024C

 50426 Bytes Available
 43960 Bytes Free

     0 Warning Error(s)
     0 Severe  Error(s)
```

```
Offset  Data   Source Line
0030    0006   REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Pattern Entry/Modif
               ication'
0030    0006   'MODULE   - "PATENT" Pattern creation, modification, and filing
               .
0030    0006   '
0030    0006   'AUTHOR   - N. A. Enevold
0030    0006   '
0030    0006   'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006   '
0030    0006   'REVISION - 1.2 03-10-86 NAE Remove Mouse inputs
0030    0006   '           1.1 02-20-86 NAE Add 80 pattern limit to save
0030    0006   '           1.0 01-13-86 NAE Creation of initial code
0030    0006   '
0030    0006   'SYSTEM   - This code can only be compiled by the BASCOM
0030    0006   '           COMPILER, it will not run under the INTERPRETER!!
0030    0006   '
0030    0006   'DESCRIPTION:
0030    0006   '       This module allows the user to LOAD, SAVE, DIRectory, D
               RAW and
0030    0006   '       enter repeat count and other parameters for a pattern t
               o be printed.
0030    0006   '       The low-resolution graphics mode is selected and a menu
               is displayed
0030    0006   '       across the bottom of the screen.  Using arrow keys
0030    0006   '       point to the action to be taken and then invoke that ac
               tion with the
0030    0006   '       Enter key.  In the DRAW mode, another menu is
0030    0006   '       displayed which allows the user to select from LINE, RE
               CTangle,
0030    0006   '       Solid RECTangle, or CIRCle pattern elements.
0030    0006   '
0030    0006   'DATA DICTIONARY
0030    0006   '       SCNDATI(50,5)     51 Row (Elements) by 6 Column array f
               or storing pattern elements
0030    0006   '       CURSORI(9)        Storage for cursor graphics icon
0030    0006   '       MENU$(6)          Up to 7 menu names can be saved here
0030    0006   '       ELNUMI            Count of number of elements in a patt
               ern
0030    0006   '       XI  YI            Current location of graphics cursor
0030    0006   '       GRID              Value of one dot space on the screen
               (default is 0.005")
0030    0006   '       ROWI  COLI        Location to print instructions
0030    0006   '       A$                Storage for single key-strokes or inp
               ut strings
0030    0006   '       MENUNUM           Which menu is being displayed (1 or 2
               )
0030    0006   '       ITEM              Pointer to which menu item is highlig
               hted (0 - 6)
0030    0006   '       REPEATI           Number of times pattern is to be repe
               ated when printed
0030    0006   '       IOFF  YOFF        X and Y axis distance between the pri
               nting of repeated patterns
0030    0006   '       ROWSP COLSP       Row and Column spacing for printing m
               ultiple sets of patterns
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030  0006  '       PATNUMZ             -   Number of patterns stored in
the pattern directory PATDIR.RJP
0030  0006  '       DROWZ  DCOLZ        Row and Column location to display di
rectory entrys
0030  0006  '       NAME$               Pattern name to be LOADed or SAVEd to
 directory
0030  0006  '       IZ  JZ              Counters used to LOAD or SAVE the ele
ment data from/to pattern data file
0030  0006  '       FILE$               Name of pattern data file
0030  0006  '       TEMPZ               Which type of element is being drawn.
  1 = Line   2 = Rectangle
0030  0006  '
 3 = Solid Rectangle  4 = Circle
0030  0006  '       FLAGZ               Same as TEMPZ above
0030  0006  '       STARTMSG$ ENDMSG$ Message display for startpoint and en
dpoint of element entry
0030  0006  '       I1Z Y1Z                     Starting cursor position for
element being drawn
0030  0006  '       DIZ DYZ                     Delta I and Y values used to
re-position cursor after arrow key
0030  0006  '       MAXITEM                     The highest number item in th
e current menu display
0030  0006  '       IS  IE              Starting and ending I position of the
 menu highlighting blue box
0030  0006  '       RADIUSZ                     The calculated radius of a ci
rcle to be displayed
0030  0006  REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  3
Pattern Entry/Modification                                             07-05-86
                                                                       10:46:13
Offset  Data   Source Line        IBM Personal Computer BASIC Compiler V2.00

0030    0006   SUB PATENTRY STATIC
0047    0006           .
0047    0006           WIDTH 40:SCREEN 1:CLS
005F    0006           DIM SCNDATZ(50,5),CURSORZ(9),MENU$(6)
0060    029A           ELNUMZ = 0:XZ=0:YZ=0:GRID = 0.005
007F    02A4
007F    02A4           LINE (0,0)-(6,6),,B
00A1    02A4           LINE (0,3)-(6,3),,B
00C5    02A4           LINE (3,0)-(3,6),,B
00E9    02A4           PRESET (3,3)
00F5    02A4           GET (0,0)-(6,6),CURSORZ
0116    02A4           CLS
011D    02A4
011D    02A4           LINE (0,0)-(319,190),,B
0140    02A4
0140    02A4           RESTORE INSTRUC
0147    02A4           FOR I=1 TO 4
0151    02A4                   READ ROWZ,COLZ,A$
0164    02AC                   LOCATE ROWZ,COLZ:PRINT A$;
0180    02AC           NEXT I
019B    02B0
019B    02B0   FIRST:
01A0    02B0           MENUNUM = 1
01AA    02B4           GOSUB SUBMENU
01B0    02B4           .
01B0    02B4           ON ITEM + 1 GOTO PATDIR, PATLOAD, PATSAVE, PATDRAW, REP
                       EAT, PATEXT
01CD    02B8           GOTO FIRST
01D0    02B8
01D0    02B8   REPEAT:
01D5    02B8           GOSUB ITEMBOXERASE:     'erase blue box around DIR
01EB    02B8           LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
01FB    02B8           LOCATE 25,1:INPUT;"Enter Repeat Count  ",REPEATZ
021B    02BA           LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
0235    02BA           LOCATE 25,1:INPUT;"Enter X Axis Offset ",XOFF
0255    02BE           LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
0272    02BE           LOCATE 25,1:INPUT;"Enter Y Axis Offset ",YOFF
0292    02C2           GOTO FIRST
0296    02C2   PATEXIT:
029B    02C2           WIDTH 80:SCREEN 0:CLS
02B2    02C2           EXIT SUB
02B6    02C2   REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  4
Pattern Entry/Modification                                             07-05-86
                                                                       10:46:13
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 02B6   02C2    PATDIR:                    'list directory of patterns
 02BB   02C2            GOSUB ITEMBOXERASE:     'erase blue box around DIR
 02C1   02C2            LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
 02DE   02C2            OPEN "PATDIR.RJP" FOR INPUT AS #1:      'open directory
 file
 02EF   02C2            INPUT #1, PATNUM%:      'read number of patterns in dir
 ectory
 0301   02C4            LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 0326   02C4            I = 0:                          'set counter
 0330   02C4
 0330   02C4    DISLOOP:
 0335   02C4            I = I + 1:              'set for next value
 0344   02C4            IF I > PATNUM% THEN GOTO DIREXIT:       'test for done
 035B   02C4            IF INT((I-1)/44) <> (I-1)/44 THEN GOTO SHOWNEXT
 0384   02C4            IF INT((I-1)/44) < 1 THEN GOTO SHOWNEXT
 03A9   02C4
 03A9   02C4            LOCATE 25,1:PRINT "More to Display. Continue ? (Y or N)
 ";
 03C3   02C4            GOSUB CORLOOP:  'wait for Y or N response
 03C9   02C4            IF A$ = "N" THEN GOTO DIREXIT:  'if N then don't contin
 ue
 030C   02C4
 030C   02C4            LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 0401   02C4
 0401   02C4    SHOWNEXT:
 0406   02C4            DROW% = ((I - 1) MOD 22) + 2:   'calculate row for disp
 lay
 0422   02C6            DCOL% = 4:                      'set column to 4
 0429   02C8            IF ((I - 1) MOD 44) > 21 THEN DCOL% = 23:'reset column
 if necessary
 044C   02C8
 044C   02C8            LINE INPUT #1, A$:      'read next name from directory
 0459   02C8            LOCATE DROW%,DCOL%:PRINT A$;    'PRINT NAME
 0475   02C8            GOTO DISLOOP
 0479   02C8
 0479   02C8    DIREXIT:
 047E   02C8            CLOSE #1:       'terminate access to PATDIR.RJP
 0485   02C8            GOTO FIRST
 0489   02C8
 0489   02C8    REM $PAGE
```

```
Offset  Data   Source Line

 0469   02C9   PATLOAD:
 048E   02C9          GOSUB ITEMBOIERASE:     'erase blue box around DIR
 0494   02C9          OPEN "PATDIR.RJP" FOR INPUT AS #1
 04A5   02C9          INPUT #1,PATNUMZ:       'read number of patterns in dir
 04A7   02C9          GOSUB GETNAME:          'prompt for and input pattern n
ame
 04BD   02C9          LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 04E2   02C9
 04E2   02C9          GOSUB SEARCH
 04E8   02C9
 04E8   02C9          IF IZ < (PATNUMZ + 1) THEN GOTO FOUND
 04FC   02C9          LOCATE 10,16-(LEN(NAME$)/2):PRINT NAME$;" not Found";
 0531   02CE          LOCATE 12,14:PRINT "Strike Any Key"
 054B   02CE          GOSUB ANYKEY:   'wait for a keyhit
 0551   02CE          GOTO FIRST
 0555   02CE
 0555   02CE   FOUND:
 055A   02CE          FILE$ = RIGHT$(STR$(IZ),LEN(STR$(IZ))-1) + "PAT.RJP"
 057E   02D2          OPEN FILE$ FOR INPUT AS #1:     'set pattern data file
for read
 058F   02D2          INPUT #1,ELNUMZ:        'read number of elements in pat
tern
 05A1   02D2          INPUT #1,GRID:          'read grid size
 05B3   02D2          INPUT #1,REPEATZ:       'read repeat count
 05C5   02D2          INPUT #1,XOFF:          'read x axis offset for repeat
 05D7   02D2          INPUT #1,YOFF:          'read y axis offset for repeat
 05E9   02D2
 05E9   02D2          FOR IZ = 0 TO ELNUMZ - 1
 05F7   02D4              FOR JZ = 0 TO 5
 05FD   02D4                  INPUT #1,SCREENZ(IZ,JZ):'read file into screen
array
 0621   02D6              NEXT JZ
 0631   02D6          NEXT IZ
 0643   02D6          CLOSE #1:       'done with data file
 064A   02D6
 064A   02D6          OPEN "PATDEF.RJP" FOR OUTPUT AS #1
 065C   02D6          PRINT #1,FILE$:                 'save filename in defau
lt file
 066C   02D6          PRINT #1,NAME$:                 'save the directory nam
e as well
 067C   02D6          CLOSE #1
 0683   02D6
 0683   02D6          GOTO REDRAW
 0687   02D6
 0687   02D6   SEARCH:
 068C   02D6          IZ = 1:                         'set entry pointer
 0693   02D6   SLOOP:
 0698   02D6          LINE INPUT #1,A$:       'read next pattern name from di
r
 06A5   02D6          IF A$ = NAME$ THEN GOTO SEARCH.END:     'compare name w
ith dir.entry
 06B8   02D6          IZ = IZ + 1
 06C1   02D6          IF IZ < (PATNUMZ + 1) THEN GOTO SLOOP:'check for done
 06D4   02D6   SEARCH.END:
```

```
Offset  Data    Source Line
 0609   0206            CLOSE #1:       'not found so close file and display me
                        ssage
 06E0   0206            RETURN
 06E4   0206
 06E4   0206    REM $PAGE
```

```
Offset  Data    Source Line
 5
 06E4   02D6    PATSAVE:
 06E9   02D6            GOSUB ITEMBOXERASE:     'erase blue box around DIR
 06EF   02D6            IF ELNUM% = 0 THEN GOTO FIRST:  'no elements in pattern
 06FE   02D6            OPEN "PATDIR.RJP" FOR INPUT AS #1
 070F   02D6            INPUT #1,PATNUM%
10  0721   02D6            IF PATNUM% < 80 THEN GOTO SAVE.PAT:     'directory full
 at 80 patterns
 0730   02D6            CLOSE #1
 0737   02D6            LOCATE 25,1:PRINT SPACE$(39);:          'erase bottom l
 ine
15  0754   02D6            LOCATE 25,1:PRINT "Directory is full (80 patterns max)"
 ;
 076E   02D6            GOSUB ANYKEY:GOTO FIRST
 0778   02D6    SAVE.PAT:
 077D   02D6            GOSUB GETNAME:  'prompt for and get pattern name
20  0783   02D6            GOSUB SEARCH
 0789   02D6            IF I% > PATNUM% THEN GOTO ADD.NEW.PATTERN
 079A   02D6            LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 07BF   02D6            LOCATE 10,13-(LEN(NAME$)/2):PRINT NAME$;" already exist
 s.";
25  07F4   02D6            LOCATE 12,15:PRINT "Replace it?"
 080E   02D6            PATNUM% = I%
 0815   02D6            A$ = ""
 081F   02D6            WHILE A$ = ""
 082E   02D6                    A$ = INKEY$
30  083B   02D6            WEND
 083B   02D6            IF A$ = "Y" OR A$ = "y" THEN GOTO SAVE.PATTERN
 0864   02D6            GOTO FIRST
 0868   02D6
 0868   02D6    ADD.NEW.PATTERN:
35  0869   02D6            KILL "PATDIR.OLD":      'delete old backup directory
 0874   02D6            NAME "PATDIR.RJP" AS "PATDIR.OLD":      'save old direc
 tory
 087E   02D6            OPEN "PATDIR.OLD" FOR INPUT AS #1
 088F   02D6            OPEN "PATDIR.RJP" FOR OUTPUT AS #2:     'set up new dir
40  08A1   02D6            INPUT #1,PATNUM%:       'read number of dir entries
 08B3   02D6            PATNUM% = PATNUM% + 1:  'increase by 1
 08BC   02D6            WRITE #2,PATNUM%:       'save in new directory
 08CD   02D6            FOR I=1 TO PATNUM% - 1
 08E6   02DA                LINE INPUT #1,A$:   'read entry from old dir
45  08F3   02DA                PRINT #2,A$:        'write entry in new directory
 0903   02DA            NEXT I
 091E   02DA            PRINT #2,NAME$:         'write new entry to new directo
 ry
 092E   02DA            CLOSE #1:CLOSE #2:      'done with directory
50  093C   02DA    SAVE.PATTERN:
 0941   02DA            FILE$ = RIGHT$(STR$(PATNUM%),LEN(STR$(PATNUM%))-1) + "P
 AT.RJP"
 0965   02DA            OPEN FILE$ FOR OUTPUT AS #1:    'create new pattern dat
 a file
55  0977   02DA            WRITE #1,ELNUM%:        'store number of elements
 0988   02DA            WRITE #1,GRID:          'store grid dimension
 0998   02DA            WRITE #1,REPEAT%:       'store repeat count
 09A9   02DA            WRITE #1,XOFF:          'store x axis offset for repeat
```

Reagent Jet Printer
Pattern Entry/Modification

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0989   02DA          WRITE #1,YOFF:          'store y axis offset for repeat
 09C9   02DA          FOR IZ = 0 TO ELMNMZ - 1
 09D7   02DC              FOR JZ = 0 TO 5
 09DD   02EC                  WRITE #1,SCNDATZ(IZ,JZ):        'write screen a
rray to file
 0A05   02EC              NEXT JZ
 0A10   02EC          NEXT IZ
 0A22   02DC          CLOSE #1:       'done with data file
 0A29   02DC          OPEN "PATDEF.RJP" FOR OUTPUT AS #1
 0A3B   02DC          PRINT #1,FILE$:                 'save filename in defau
lt file
 0A4B   02DC          PRINT #1,NAME$:                 'save the directory nam
e as well
 0A5B   02DC          CLOSE #1
 0A62   02DC          GOTO FIRST
 0A66   02DC     REM $PAGE
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

0A6a    02DC   PATCRAW:
0A6E    02DC          GOSUB ITEMSOIERASE
0A71    02DC          LINE (1,1)-(318,189),0,BF:      'Erase graphics tablet
0A96    02DC
0A96    02DC   NEXTEL:
0A98    02DC          MENUNUM = 2
0AA5    02DC          GOSUB SUBMENU
0AAB    02DC
0AAB    02DC          ON ITEM + 1 GOTO ALINE, RECT, SRECT, ACIRCLE, REDRAW, B
                ACKUP
0ACB    02DC          GOTO NEXTEL
0ACB    02DC
0ACB    02DC   BACKUP:
0AD0    02DC          GOSUB ITEMBOIERASE
0AD6    02DC          GOTO FIRST
0ADA    02DC
0ADA    02DC   ALINE:
0ADF    02DC          TEMP% = 1
0AE6    02DE          STARTMSG$ = "STARTING ENDPOINT"
0AF0    02E2          ENDMSG$ = "ENDING ENDPOINT  "
0AFA    02E6          GOTO ENTERELEMENT
0AFE    02E6
0AFE    02E6   RECT:
0B03    02E6          TEMP% = 2
0B0F    02E6          GOTO RECTMSG
0B0E    02E6
0B0E    02E6   SRECT:
0B13    02E6          TEMP% = 3
0B1A    02E6   RECTMSG:
0B1F    02E6          STARTMSG$ = "STARTING CORNER"
0B29    02E6          ENDMSG$ = "ENDING CORNER  "
0B33    02E6          GOTO ENTERELEMENT
0B37    02E6
0B37    02E6   ACIRCLE:
0B3C    02E6          TEMP% = 4
0B43    02E6          STARTMSG$ = "CENTER OF CIRCLE"
0B4D    02E6          ENDMSG$ = "POINT ON CIRCLE  "
0B57    02E6
0B57    02E6   ENTERELEMENT:
0B5C    02E6          GOSUB ITEMBOIERASE
0B62    02E6          FLAG%=0
0B69    02E8          LOCATE 25,1:PRINT SPACE$(39);
0B86    02E8          LOCATE 25,1:PRINT STARTMSG$;
0BA0    02E8          GOSUB DISPCURSOR
0BA6    02E8   FINDSTART:
0BAB    02E8          GOSUB MOUSEACT
0BB1    02E8          IF A$ = CHR$(27) THEN GOTO ABORT
0BC8    02E8          IF A$ = CHR$(13) THEN GOTO SETSTART
0BCF    02E8          GOSUB CURSORMOVE
0BE5    02E8          GOTO FINDSTART
0BEE    02E8   ABORT:
0BED    02E8          GOSUB PLACECURSOR
0BF3    02E8          GOTO NEXTEL
0BF7    02E8
```

```
Offset  Data   Source Line
 0BF7   02EB   SETSTART:
 0BFC   02EB           LOCATE 25,1:PRINT ENDMSG$;
 0C16   02EB           FLAGZ = TEMPZ:X1Z = XZ:Y1Z = YZ
 0C28   02EC           IF FLAGZ = 4 THEN PSET (XZ+4,YZ+4)
 0C35   02EC   FINDEND:
 0C3A   02EC           GOSUB MOUSEACT
 0C40   02EC           IF A$ = CHR$(27) THEN GOTO CANCELEL
 0C77   02EC           IF A$ = CHR$(13) THEN GOTO SAVEEL
 0C8E   02EC           GOSUB CURSORMOVE
 0C94   02EC           GOTO FINDEND
 0C97   02EC   CANCELEL:
 0C9C   02EC           GOSUB PLACECURSOR
 0CA2   02EC           ON FLAGZ GOSUB ER1, ER2, ER3, ER4
 0CB3   02EC           FLAGZ = 0
 0CBA   02EC           GOTO NEXTEL
 0CBE   02EC   SAVEEL:
 0CC3   02EC           GOSUB PLACECURSOR
 0CC9   02EC           IF FLAGZ = 4 THEN CIRCLE (X1Z+4,Y1Z+4),SQR((XZ-X1Z)^2+(
                       YZ-Y1Z)^2),,,,1
 0D32   02EC           GOSUB CORRECT
 0D38   02EC           IF A$="N" THEN GOTO REDRAW
 0D4B   02EC   STOREEL:
 0D50   02EC           SCNDATZ(ELNUMZ,0) = FLAGZ
 0D6A   02EC           SCNDATZ(ELNUMZ,1) = X1Z
 0D85   02EC           SCNDATZ(ELNUMZ,2) = Y1Z
 0DA0   02EC           SCNDATZ(ELNUMZ,3) = XZ
 0DBB   02EC           SCNDATZ(ELNUMZ,4) = YZ
 0DD6   02EC           SCNDATZ(ELNUMZ,5) = 0
 0DEF   02EC           ELNUMZ = ELNUMZ + 1
 0DFB   02EC           FLAGZ = 0
 0DFF   02EC           GOTO NEXTEL
 0E03   02EC    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0E03    02EC    REDRAW:
0E08    02EC            GOSUB ITEMBOXERASE
0E0E    02EC            LINE(1,1)-(318,189),0,BF
0E33    02EC            IF ELNUM% = 0 THEN GOTO NEXTEL
0E42    02EC
0E42    02EC            FOR I=0 TO ELNUM%-1
0E5B    02F0                    ON SCNDATX(I,0) GOSUB RD1, RD2, RD3, RD4
0E81    02F0            NEXT I
0E9C    02F0            GOTO NEXTEL
0EA0    02F0
0EA0    02F0    '******** Sub-routines called by main module ********
0EA0    02F0
0EA0    02F0    SUBMENU:
0EA5    02F0
0EA5    02F0            LOCATE 25,1:PRINT SPACE$(39);
0EC2    02F0            ON MENUNUM GOSUB MENU1, MENU2
0ED1    02F0
0ED1    02F0            FOR I=0 TO 6
0EDB    02F0                    READ MENU$(I)
0EF2    02F0                    LOCATE 25,(I*6)+2:PRINT MENU$(I);
0F2B    02F0            NEXT I
0F46    02F0
0F46    02F0            READ MAXITEM
0F4D    02F4            ITEM = 0
0F57    02F4
0F57    02F4    NEWITEM:
0F5C    02F4            GOSUB NEWITEMBOX
0F62    02F4
0F62    02F4    NEXTITEM:
0F67    02F4            GOSUB ITEMSEARCH
0F6D    02F4            IF A$ = CHR$(13) THEN RETURN;'  ITEM has correct value
0F84    02F4            IF LEN(A$) < 2 THEN BEEP:GOTO NEXTITEM
0F9A    02F4            IF ASC(MID$(A$,2,1)) = 75 THEN GOTO LEFTAR
0FB6    02F4            IF ASC(MID$(A$,2,1)) = 77 THEN GOTO RIGHTAR
0FD2    02F4            BEEP:GOTO NEXTITEM
0FD9    02F4
0FD9    02F4    LEFTAR:
0FDE    02F4            IF ITEM = 0 THEN GOTO NEXTITEM
0FEE    02F4            GOSUB ITEMBOXERASE
0FF4    02F4            ITEM = ITEM - 1
1003    02F4            GOTO NEWITEM
1007    02F4
1007    02F4    RIGHTAR:
100C    02F4            IF ITEM = MAXITEM THEN GOTO NEXTITEM
101F    02F4            GOSUB ITEMBOXERASE
1025    02F4            ITEM = ITEM + 1
1034    02F4            GOTO NEWITEM
1038    02F4
1038    02F4    MENU1:
103D    02F4            RESTORE MN1
1044    02F4            RETURN
1048    02F4
1048    02F4    MENU2:
104D    02F4            RESTORE MN2
```

```
Offset  Data   Source Line        IBM Personal Computer BASIC Compiler V2.00

1054    02F4          RETURN
1058    02F4
1058    02F4    ITEMSEARCH:
1058    02F4          A$ = INKEY$:IF A$ <> "" THEN RETURN
107A    02F4          GOTO ITEMSEARCH
107D    02F4          RETURN
1081    02F4
1081    02F4    NEWITEMBOX:
1086    02F4          IS = (ITEM*48) + 7
109C    02FB          IE = (ITEM*48) + 8 + LEN(MENU$(ITEM))*8
10D9    02FC          LINE (IS,191)-(IE,199),1,B
1101    02FC          RETURN
1105    02FC
1105    02FC    ITEMBOXERASE:
110A    02FC          LINE (IS,191)-(IE,199),0,B
1131    02FC          RETURN
1135    02FC
1135    02FC    PLACECURSOR:
113A    02FC          PUT (XZ+1,YZ+1),CURSCRZ
1157    02FC          RETURN
1158    02FC
1158    02FC    MOUSEACT:
1160    02FC          GOSUB ANYKEY
1166    02FC          DXZ = 0 : DYZ = 0
1174    0300          IF A$ = CHR$(0) + CHR$(72) THEN DYZ = -1:RETURN
119D    0300          IF A$ = CHR$(0) + CHR$(80) THEN DYZ =  1:RETURN
11C6    0300          IF A$ = CHR$(0) + CHR$(77) THEN DXZ =  1:RETURN
11EF    0300          IF A$ = CHR$(0) + CHR$(75) THEN DXZ = -1:RETURN
1218    0300          IF A$ = "8" THEN DYZ = -20:RETURN
1232    0300          IF A$ = "2" THEN DYZ =  20:RETURN
124C    0300          IF A$ = "4" THEN DXZ = -20:RETURN
1266    0300          IF A$ = "6" THEN DXZ =  20:RETURN
1280    0300          IF A$ = CHR$(27) THEN RETURN
1297    0300          IF A$ = CHR$(13) THEN RETURN
12AE    0300          GOTO MOUSEACT
12B2    0300
12B2    0300    CURSORMOVE:
12B7    0300          GOSUB PLACECURSOR
12BB    0300          ON FLAGZ GOSUB ER1, ER2, ER3, ER4
12CE    0300          XZ = XZ + DXZ : YZ = YZ + DYZ
12E6    0300          IF XZ < 0 THEN XZ = 0
12F8    0300          IF XZ > 311 THEN XZ = 311
1308    0300          IF YZ < 0 THEN YZ = 0
1310    0300          IF YZ > 182 THEN YZ = 182
1330    0300          ON FLAGZ GOSUB DR1, DR2, DR3, DR4
1341    0300          GOSUB DISPCURSOR
1347    0300          RETURN
1348    0300
1348    0300    CORRECT:
1350    0300          LOCATE 25,1:PRINT SPACE$(39);
136D    0300          LOCATE 25,1:PRINT "IS THIS CORRECT? (Y or N) ";
1387    0300    CORLOOP:
138C    0300          GOSUB ANYKEY
1392    0300          IF A$ = "y" OR A$ = "Y" THEN A$ = "Y":GOTO COREXIT
```

```
Offset  Data    Source Line
 13C5   0300            IF A$ = "n" OR A$ = "N" THEN A$ = "N":GOTO COREXIT
 13F8   0300            GOTO CORLOOP
 13FB   0300    COREXIT:
 1400   0300            LOCATE 25,1:PRINT SPACE$(39);
 1410   0300            RETURN
 1421   0300
 1421   0300    DISPCURSOR:
 1426   0300            GOSUB PLACECURSOR
 142C   0300            LOCATE 25,27:PRINT USING "+#.###";IX * GRID;
 1456   0300            PRINT ",";
 1463   0300            PRINT USING "+#.###";YX * GRID;
 1480   0300            RETURN
 1484   0300
 1484   0300
 1484   0300    KD1:
 1489   0300            LINE(SCNDATX(I,1)+4,SCNDATX(I,2)+4)-(SCNDATX(I,3)+4,SCN
                        DATX(I,4)+4)
 1522   0300            RETURN
 1526   0300
 1526   0300    RD2:
 152B   0300            LINE(SCNDATX(I,1)+4,SCNDATX(I,2)+4)-(SCNDATX(I,3)+4,SCN
                        DATX(I,4)+4),,B
 15C4   0300            RETURN
 15C8   0300
 15C8   0300    RD3:
 15CD   0300            LINE(SCNDATX(I,1)+4,SCNDATX(I,2)+4)-(SCNDATX(I,3)+4,SCN
                        DATX(I,4)+4),,BF
 1667   0300            RETURN
 1668   0300
 1668   0300    RD4:
 1670   0300            RADIUSX = SQR((SCNDATX(I,3)-SCNDATX(I,1))^2 + (SCNDATX(
                        I,4)-SCNDATX(I,2))^2)
 16FF   0302            CIRCLE (SCNDATX(I,1)+4,SCNDATX(I,2)+4),RADIUSX,,,,1
 175D   0302            RETURN
 1761   0302
 1761   0302    DR1:
 1766   0302            LINE (IIX+4,YIX+4)-(IX+4,YX+4)
 17AF   0302            RETURN
 17B3   0302
 17B3   0302    DR2:
 17B8   0302            LINE (IIX+4,YIX+4)-(IX+4,YX+4),,B
 1801   0302            RETURN
 1805   0302
 1805   0302    DR3:
 180A   0302            LINE (IIX+4,YIX+4)-(IX+4,YX+4),,BF
 1854   0302            RETURN
 1858   0302
 1858   0302    DR4:
 185D   0302            RETURN
 1861   0302
 1861   0302    ER1:
 1866   0302            LINE (IIX+4,YIX+4)-(IX+4,YX+4),0
 18AF   0302            RETURN
 18B3   0302
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

 1883   0302   ER2:
 1888   0302          LINE (X1%+4,Y1%+4)-(X%+4,Y%+4),0,B
 1901   0302          RETURN
 1905   0302
 1905   0302   ER3:
 190A   0302          LINE (X1%+4,Y1%+4)-(X%+4,Y%+4),0,BF
 1954   0302          RETURN
 1958   0302
 1959   0302   ER4:
 195D   0302          RETURN
 1961   0302
 1961   0302   ANYKEY:
 1966   0302          A$ = ""
 1970   0302          WHILE A$ = ""
 197F   0302                A$ = INKEY$
 1989   0302          WEND
 198C   0302          RETURN
 1990   0302
 1990   0302   GETNAME:        'prompt for and get filename
 1995   0302          LOCATE 25,1:PRINT SPACE$(39);
 1982   0302          LOCATE 25,38:PRINT "<";:        'boundry chevron
 19CC   0302          LOCATE 25,1:PRINT "Enter Pattern Name    ";
 19E6   0302          LINE INPUT; "",NAME$
 19F4   0302          RETURN
 19F8   0302
 19F8   0302   ' Data fields used by this module
 19F8   0302
 19F8   0302   MN1:
 19FD   0302          DATA "DIR","LOAD","SAVE","DRAW","REPT","EXIT","",5
 19FF   0302
 19FF   0302   MN2:
 1A04   0302          DATA "LINE","RECT","ERECT","CIRCL","REDRW","MAIN","",5
 1A06   0302
 1A06   0302   INSTRUC:
 1A0B   0302          DATA 8,16,"USE ARROWS"
 1A0D   0302          DATA 10,9,"TO SELECT FROM THE MENU"
 1A0F   0302          DATA 14,12,"USE THE ENTER KEY"
 1A11   0302          DATA 16,10,"TO ACTIVATE SELECTION"
 1A13   0302
 1A13   0302   END SUB
 1A1A   0302
 21AF   0302

50426 Bytes Available
43373 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

0030    0006   REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Burr-Brown PCI-2000
               0 custom driver'
0030    0006   'MODULE   - "PCI" Driver for the PCI-20000 I/O and PULSE cards
0030    0006   '
0030    0006   'AUTHOR   - M. S. Fairchild of Computing Architects Inc.
0030    0006   '                            113 Fairfield Way
0030    0006   '                            Bloomingdale, Il 60108
0030    0006   '                            312/980-6777
0030    0006   '
0030    0006   'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006   '
0030    0006   'REVISION - 1.2 12-16-85 MSF Add digital I/O initalization, and
               output routine
0030    0006   '
0030    0006   '          - 1.1 12-10-85 MSF Move counter module to position 2
0030    0006   '
0030    0006   '          - 1.0 11-22-85 MSF Creation of initial code
0030    0006   '
0030    0006   'SYSTEM   - This code can only be compiled by the BASCOM V2
0030    0006   '            COMPILER, it will not run under the INTERPRETER!!
0030    0006   '
0030    0006   'DESCRIPTION:
0030    0006   '                The PCI module is a group of routines used to a
               ccess
0030    0006   '       the BURR-Brown PCI-20000 board. The supplied software c
               auses
0030    0006   '       the Wordstar2000 software to malfunction and will not p
               rivide
0030    0006   '       explicit on, off functions for the counters.  Custom dr
               ivers
0030    0006   '       will be made to provide all of the desired functions.
0030    0006   '       '
0030    0006   '
0030    0006   '       Address         Register
0030    0006   '       &HC0000 Carrier I.D. / module present (R)
0030    0006   '       &HC0040 Module interrupt status (R)
0030    0006   '       &HC0080 Digital I/O port 0 (R/W)
0030    0006   '       &HC0081 Digital I/O port 1 (R/W)
0030    0006   '       &HC0082 Buffer direction and enable (R/W)
0030    0006   '       &HC0083 Control for ports 0 and 1 (W)
0030    0006   '       &HC00C0 Digital I/O port 2 (R/W)
0030    0006   '       &HC00C1 Digital I/O port 3 (R/W)
0030    0006   '       &HC00C3 Control for ports 2 and 3 (W)
0030    0006
0030    0006   '       &HC0200         Read module I.D. (1110 1010)
0030    0006   '       &HC0204         Rate generator low-order 16 bits (0)
0030    0006   '       &HC0205         Rate generator high-order 16 bits (1)
0030    0006   '       &HC0206         Counter 3 count register (2)
0030    0006   '       &HC0207         Rate generator/counter 3 control
0030    0006   '       &HC0208         Counter 0 count register (0)
0030    0006   '       &HC0209         Counter 1 count register (1)
0030    0006   '       &HC020A         Counter 2 count register (2)
0030    0006   '       &HC020B         Counter 0 - 2 control
0030    0006   '       &HC020C         Counter gate control (1 enables, 0 disa
               '
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
                bles:
0030  0006  '              bit     function
0030  0006  '              0       Rate generator gate
0030  0006  '              1       Rate generator gate
0030  0006  '              2       Counter 0 gate
0030  0006  '              3       Counter 1 gate
0030  0006  '              4       Counter 2 gate
0030  0006  '              5       Counter 3 gate
0030  0006  '              6       Not used
0030  0006  '              7       Not used
0030  0006  '
0030  0006  '
0030  0006  'DATA DICTIONARY
0030  0006  '
0030  0006  '      COUNT   - Divisor to 2Mhz rate to give desired frequenc
                y or time
0030  0006  '      COUNTHZ         - High order 16 bits of a 32 bit diviso
                r
0030  0006  '      COUNTLZ - Low order 16 bits of a 32 bit divisor
0030  0006  '      LSBZ    - Lower 8 bits of a 16 bit divisor
0030  0006  '      MSBZ    - Upper 8 bits of a 16 bit divisor
0030  0006
0030  0006  ' Main line code
0030  0006  '      The main line code is never executed. It's sole purpose
                 it to
0030  0006  ' declare shared the variables that will be used in the subrout
                ines
0030  0006  ' so that they will all be defined and hold their values.
0030  0006
0030  0006  MAIN:_
0030  0006          DIM SHARED COUNT,COUNTHZ,COUNTLZ,LSBZ,MSBZ
0030  0006
0030  0006  MAINLOOP:_
0030  0006          GOTO MAINLOOP
004C  0012
004C  0012  REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
004C  0012  'SUBROUTINE     - PCI.INIT
004C  0012  '
004C  0012  'DESCRIPTION:
004C  0012  '       The PCI.INIT subroutine initalizes the PCI hardware.
004C  0012
004C  0012  SUB PCI.INIT STATIC
0053  0012
0053  0012          DEF SEG = &HC000: 'Point segment to PCI-20000 board
005A  0012
005A  0012          POKE &H020C,&H00: 'Disable all software enabled counter
                    s
0063  0012
0063  0012  ' Configure rate generator to 2 Khz
0063  0012
0063  0012          POKE &H0207,&H34: 'Set low rate counter to mode 2
006D  0012          POKE &H0207,&H74: 'Set high rate counter to mode 2
0077  0012          POKE &H0204,&H02: 'Load low rate counter with 16 bits o
                    f 2
0081  0012          POKE &H0204,&H00
008A  0012          POKE &H0205,&H02: 'Load high rate counter with 16 bits
                    of 2
0094  0012          POKE &H0205,&H00
009D  0012          POKE &H020C,&H03: 'Enable rate counters
00A7  0012
00A7  0012  ' Configure dot rate counters (default to 5 Khz)
00A7  0012
00A7  0012          POKE &H0208,&H34: 'Set low dot counter (0) to mode 2
00B1  0012          POKE &H0208,&H74: 'Set high dot counter (1) to mode 2
00BB  0012          POKE &H0208,&H04: 'Load low rate counter with 16 bits o
                    f 4
00C5  0012          POKE &H0209,&H00
00CE  0012          POKE &H0209,&H64: 'Load high rate counter with 16 bits
                    of 100
00D8  0012          POKE &H0209,&H00
00E1  0012
00E1  0012  ' Configure dot pulse with one shot (default to 13 usec)
00E1  0012
00E1  0012          POKE &H0208,&H82: 'Set dot pulse with oneshot (2) to mo
                    de 1
00EB  0012          POKE &H020A,&H1A: 'Load oneshot with 16 bits of 26
00F5  0012          POKE &H020A,&H00
00FE  0012
00FE  0012  ' Configure shifted strobe pulse one shot (default to .5 usec)
00FE  0012
00FE  0012          POKE &H0207,&H82: 'Set shifted strobe onshot (3) to mod
                    e 1
0108  0012          POKE &H0206,&H01: 'Load oneshot with 16 bits of 1
0112  0012          POKE &H0206,&H00
011B  0012
011B  0012  ' Configure port 0 to output and port 1 to input
011B  0012
011B  0012          POKE &H0083,&H82: ' Set up I/O chip
0125  0012          POKE &H0082,&H34: ' Set up direction and enable buffers
012F  0012          POKE &H0080,&H00: ' Dissable print head
```

```
Reagent Jet Printer                                                    PAGE  4
Burr-Brown PCI-20000 custom driver                                     06-30-86
                                                                       08:38:16
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 013A   0012          END SUB
 013F   0012
 013F   0012    REM $PAGEIF:12
 013F   0012    'SUBROUTINE     - DOT.ON
 013F   0012    '
 013F   0012    'DESCRIPTION:
 013F   0012    '       The DOT.ON subroutine enables the dot frequency counter
                s.
 013F   0012
 013F   0012    SUB DOT.ON STATIC
 0146   0012
 0146   0012          POKE &H020C,&H0F: 'Enable dot counters and rate generat
                or
 0150   0012
 0150   0012          END SUB
 0157   0012
 0157   0012    REM $PAGEIF:12
 0157   0012    'SUBROUTINE     - DOT.OFF
 0157   0012    '
 0157   0012    'DESCRIPTION:
 0157   0012    '       The DOT.OFF subroutine disables the dot counters
 0157   0012
 0157   0012    SUB DOT.OFF STATIC
 015E   0012
 015E   0012          POKE &H020C,&H03: 'Disable dot counters and enable rate
                 generator
 0168   0012
 0168   0012          END SUB
 016F   0012
 016F   0012    REM $PAGEIF:49
```

IBM Personal Computer BASIC Compiler V2.00

```
Offset  Data    Source Line

016F    0012    'SUBROUTINE     - SET.DOT.RATE
016F    0012    '
016F    0012    'DESCRIPTION:
016F    0012    '       The SET.DOT.RATE subroutine loads the dot rate counters
016F    0012    ' with the desired dot frequency. Allowed range is 10,000 to 1
                Hz.
016F    0012    ' The FREQ parameter is a real number in Hz.
016F    0012
016F    0012    SUB SET.DOT.RATE(FREQ) STATIC
0176    0012
0176    0012    ' Limit freqency to in range
0176    0012
0176    0012            IF FREQ < 1 THEN FREQ = 1
018F    0012            IF FREQ > 10000 THEN FREQ = 10000
01A8    0012
01A8    0012    ' Convert to count and check for 16 bit count or 32 bit count
01A8    0012
01A8    0012            COUNT = 2E6 / FREQ
01B8    0012            IF COUNT < 65536! THEN GOTO DIVIDE16 ELSE GOTO DIVIDE32
01CF    0012
01CF    0012    ' Process count of 32 bits
01CF    0012
01CF    0012    DIVIDE32:_
01D0    0012            COUNTLI = INT((COUNT/32768!) + 1): 'Stage lower count
01F0    0012            COUNTHI = INT(COUNT/COUNTLI): 'Form upper count
020B    0012            GOTO SET.COUNT
020F    0012
020F    0012    ' Process count of 16 bits
020F    0012            '
020F    0012    DIVIDE16:
0214    0012            COUNTLI = 2
021B    0012            COUNTHI = INT(COUNT/2)
0232    0012            GOTO SET.COUNT
0236    0012
0236    0012    ' Send the derived counts out to the counters
0236    0012
0236    0012    SET.COUNT:_
0237    0012            LSBI = COUNTLI MOD 256: ' Send out low 16 bits
0248    0012            MSBI = INT(COUNTLI / 256)
025B    0012            POKE &H0208,LSBI
0273    0012            POKE &H0208,MSBI
028B    0012
028B    0012            LSBI = COUNTHI MOD 256: 'Send out high 16 bits
0291    0012            MSBI = INT(COUNTHI / 256)
02AC    0012            POKE &H0209,LSBI
02BC    0012            POKE &H0209,MSBI
02CC    0012
02CC    0012            END SUB
02D3    0012
02D3    0012    REM $PAGEIF:27
```

```
Offset  Data   Source Line
 02D3   0012   'SUBROUTINE     - SET.DOT.WIDTH
 02D3   0012   '
 02D3   0012   'DESCRIPTION:
 02D3   0012   '       The SET.DOT.WIDTH subroutine loads the dot width one sh
                ot
 02D3   0012   ' with the desired dot pulse width. Allowed range is .5 to 16,0
                00 usec.
 02D3   0012   ' The dwidth parameter is a real number in usec.
 02D3   0012
 02D3   0012   SUB SET.DOT.WIDTH(DWIDTH) STATIC
 02DA   0012
 02DA   0012   ' Limit width to in range
 02DA   0012
 02DA   0012           IF DWIDTH < .5 THEN DWIDTH = .5
 02F3   0012           IF DWIDTH > 16000 THEN DWIDTH = 16000
 030C   0012
 030C   0012   ' Convert to count
 030C   0012
 030C   0012           COUNT = DWIDTH / .5
 031A   0012
 031A   0012   ' Send the derived count out to the counter
 031A   0012
 031A   0012           LSB% = INT(COUNT MOD 256): ' Send out 16 bits
 0331   0012           MSB% = INT(COUNT / 256)
 0348   0012           POKE &H020A,LSB%
 0358   0012           POKE &H020A,MSB%
 0368   0012
 0368   0012           END SUB
 036F   0012
 036F   0012   REM $PAGEIF:27
```

```
Offset  Data   Source Line

036F    0012   'SUBROUTINE     - SET.STROBE.DELAY
036F    0012   '
036F    0012   'DESCRIPTION:
036F    0012   '       The SET.STROBE.DELAY subroutine loads the strobe delay
                one shot
036F    0012   ' with the desired strobe delay time. Allowed range is .5 to 16
                ,000 usec.
036F    0012   ' The delay parameter is a real number in usec.
036F    0012
036F    0012   SUB SET.STROBE.DELAY(DELAY) STATIC
0376    0012
0376    0012   ' Limit delay to in range
0376    0012
0376    0012           IF DELAY < .5 THEN DELAY = .5
036F    0012           IF DELAY > 16000 THEN DELAY = 16000
03A8    0012
03A8    0012   ' Convert to count
03A8    0012
03A8    0012           COUNT = DELAY / .5
03B6    0012
03B6    0012   ' Send the derived count out to the counter
03B6    0012
03B6    0012           LSB% = INT(COUNT MOD 256): ' Send out 16 bits
03C0    0012           MSB% = INT(COUNT / 256)
03E4    0012           POKE &H0206,LSB%
03F4    0012           POKE &H0206,MSB%
0404    0012
0404    0012           END SUB
040B    0012
040B    0012   REM $PAGEIF:16
040B    0012   'SUBROUTINE     - DIGITAL.OUT
040B    0012   '
040B    0012   'DESCRIPTION:
040B    0012   '       The DIGITAL.OUT subroutine sends the passed integer to
                the output
040B    0012   '        port 0.
040B    0012
040B    0012   SUB DIGITAL.OUT(BYTE%) STATIC
0412    0012
0412    0012   ' Send the byte to the port
0412    0012
0412    0012           POKE &H0080,BYTE%
0423    0012
0423    0012           END SUB
042A    0012
057F    0012

50426 Bytes Available
48723 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Reagent Jet Printer                                                    PAGE
Pattern Printing                                                       09-1
                                                                       06:4
                                                  IBM Personal Computer BASIC Compiler V
Offset  Data    Source Line

0030    0004    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Pattern Printing' $LINESIZE:132
0030    0004    'MODULE   - "PATPRINT"
0030    0004    '
0030    0004    'AUTHOR   - M. A. Ensvold
0030    0004    '
0030    0004    'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0004    '
0030    0004    'REVISION - 2.0 07-02-86 MAE Modified for MicroFab Printhead
0030    0004    '         - 1.1 03-07-85 MAE Added notes and final touches
0030    0004    '           1.0 02-03-86 MAE Creation of initial code
0030    0004    '
0030    0004    'SYSTEM   - This code can only be compiled by the BASCOM
0030    0004    '           COMPILER, it will not run under the INTERPRETER!!
0030    0004    '
0030    0004    'DESCRIPTION:
0030    0004    '       The printing module displays a menu in 3 columns of 4 rows each.  The first
0030    0004    '       column has data from the default reagent profile.  The second column has
0030    0004    '       data from the default pattern file.  The third column has standard printing
0030    0004    '       data.  The four arrow keys allow different menu items to be highlighted and
0030    0004    '       the values can be changed with the + or - keys or by entering the new number
0030    0004    '       followed by Enter.  P will cause the pattern to be printed, S will select the
0030    0004    '       notepad, and E will exit to the main program.  On the notepad, any single line
0030    0004    '       entered here will be sent to the printer.  A null line exits the notepad.
0030    0004    '
0030    0004    'DATA DICTIONARY
0030    0004    '       MENU%           Which menu item is highlighted (0-17)
0030    0004    '       DIFF%           Where to move menu highlight in response to arrow key
0030    0004    '       TYPE%           What key was been pressed during main scan
0030    0004    '       ELMNT%          Number of elements in current pattern
0030    0004    '       SCREATE%(20,5)  Array for storing elements in current pattern
0030    0004    '       REPEAT%         Counter for repeat printing the pattern
0030    0004    '       CT%             Counter for stepping through the pattern array during printing
0030    0004    '       RADIUS%         Radius of circle during printing
0030    0004    '       X% Y%           Offsets for start row/column position
0030    0004    '       REPX% REPY%     Repeat distances for repeat printing of patterns
0030    0004    '       SX% SY%         Starting X and Y positions for solid rectangles
0030    0004    '       EX% EY%         Ending X and Y positions for solid rectangles
0030    0004    '       I% J%           Counters used for reading pattern files into the array
0030    0004    '       TEMP%           Register for misc. integers
0030    0004    '       NOTELINE%       Pointer to which line is active in the notepad
0030    0004    '       MENUS(17,1)     Array of strings used to display menu items
0030    0004    '       A$              Single keystroke input destination
0030    0004    '       NOTE$           String entered in notepad and sent to printer
0030    0004    '       KEYBUF$         String entered from main scan and assigned to number of string field
0030    0004    '       REAGENT$        Name of default reagent
0030    0004    '       PATNAME$        Name of default pattern
0030    0004    '       FILE$           Name of reagent data file and then pattern data file
0030    0004    '       MENU(11,4)      Array of values used in displaying menu item numbers
0030    0004    '       TEMP            Register for the temporary storage of real numbers
0030    0004    REM $PAGE
```

```
5  Reagent Jet Printer                                                                    PAGE
   Pattern Printing                                                                       09-1
                                                                                          08:4
                                                                  IBM Personal Computer BASIC Compiler V.

   Offset  Data    Source Line

0030  0066  SUB PATPRINT STATIC
10 0047  0066
0047  0066        DIM SCNDATA(80,5),MENU$(17,1),MENU(17,4)
0048  0462
0048  0462        GOSUB INITIALIZE:       'read init. values and set screen
004E  0462
004E  0462        WHILE TYPE% <> 1
15 0059  0464
0059  0464          TYPE% = 0
0060  0464          A$ = ""
0064  0468
006A  0468          WHILE A$ = ""
0079  0468            A$ = INKEY$
20 0083  0468          WEND
0086  0468
0086  0468          IF A$ = "E" OR A$ = "e" THEN TYPE% = 1:       'exit sub
00B2  0468          IF A$ = "P" OR A$ = "p" THEN TYPE% = 2:       'print pattern
00DE  0468          IF A$ = "+" THEN TYPE% = 3:                   'increment variable
00F4  0468          IF A$ = "-" THEN TYPE% = 4:                   'decrement variable
25 010A  0468          IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 5:    'up arrow key
012F  0468          IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 6:    'down arrow key
0154  0468          IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 7:    'left arrow key
0179  0468          IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 8:    'right arrow key
019E  0468          IF A$ > CHR$(47) AND A$ < CHR$(58) THEN TYPE% = 9:' number 0-9
30 01D6  0468          IF A$ = "S" OR A$ = "s" THEN TYPE% = 10:      'enter scratchpad
0202  0468
0202  0468          ON TYPE% GOSUB T1, T2, T3, T4, T5, T6, T7, T8, T9, T10
021F  0468
021F  0468        WEND
0223  0468        TYPE% = 0
35 0224  0468
022A  0468        EXIT SUB
022E  0468
022E  0468  '********** SUBROUTINES FOR THIS MODULE **********
022E  0468  T10:    'scratch pad
0233  0468        SCREEN 0,0,2,2:COLOR 7,0
40 0256  0468        LOCATE NOTELINE%,1
0264  046A  NOTELOOP:
0269  046A        LINE INPUT NOTE$
0277  046E        IF NOTE$ = "" THEN SCREEN 0,0,0,0:RETURN
029F  046E        LPRINT NOTE$
02AC  046E        IF NOTELINE% < 24 THEN NOTELINE% = NOTELINE% + 1
45 02C0  046E        GOTO NOTELOOP
02C3  046E
02C3  046E
02C3  046E  T1:
02C8  046E        RETURN:                 'exit to print menu, no action
02CC  046E
50 02CC  046E  T3:          'process "+" key
02D1  046E        IF MENU(MENUZ,0) >= MENU(MENUZ,1) THEN MENU(MENUZ,0) = MENU(MENUZ,1):RETURN:    'check max value
033C  0470        MENU(MENUZ,0) = MENU(MENUZ,0) + MENU(MENUZ,3):  'add increment
0372  0470        COLOR 0,7:GOSUB DISPMENU:RETURN:                'show new value
0388  0470
0388  0470  T4:          'process "-" key
55
```

```
5   Reagent Jet Printer                                                                                    PAGE
    Pattern Printing                                                                                       C9-17
                                                                                                           08:49
    Offset  Data    Source Line                                                  IBM Personal Computer BASIC Compiler V2

0382    0470        IF MENU(MENUZ,0) <= MENU(MENUZ,2) THEN MENU(MENUZ,0) = MENU(MENUZ,1):RETURN:    'check min value
10  03F8    0470    MENU(MENUZ,0) = MENU(MENUZ,0) - MENU(MENUZ,3):  'sub increment
042E    0470        COLOR 0,7:GOSUB DISPMENU:RETURN:                    'show new value
0444    0470
0444    0470    T5:         'process up arrow key
0449    0470        IF MENUZ MOD 6 = 0 THEN RETURN:             'in top row already
045I    0470        DIFFI = -1:GOSUB NEWMENU:RETURN:        'move pointer up one
15  046F    0472
0467    0472    T6:         'process down arrow key
0474    0472        IF MENUZ MOD 6 = 5 THEN RETURN:             'in bottom row already
048A    0472        DIFFI = 1:GOSUB NEWMENU:RETURN:             'move pointer down one
0498    0472
0498    0472    T7:         'process left arrow key
20  04A0    0472        IF INT(MENUZ / 6) = 0 THEN RETURN       'in left column already
04C0    0472        DIFFI = -6:GOSUB NEWMENU:RETURN:        'move pointer one left
0401    0472
0401    0472    T8:         'process right arrow key
0406    0472        IF INT(MENUZ / 6) = 2 THEN RETURN       'in right column already
25  04F9    0472        DIFFI = 6:GOSUB NEWMENU:RETURN:             'move pointer one right
050A    0472
050A    0472    T9:         'input keys into KEYBUF$ until (cr) is entered
050F    0472        LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0541    0472        KEYBUF$ = A$
0548    0476        WHILE A$ <> CHR$(13)
30  055E    0476            LOCATE 25,47:PRINT SPACE$(20);
0578    0476            LOCATE 25,47:PRINT KEYBUF$;
0595    0476            A$ = ""
05BF    0476            WHILE A$ = ""
05AE    0476                A$ = INKEY$
05BB    0476            WEND
35  05BB    0476            IF A$ = CHR$(8) AND LEN(KEYBUF$) > 0 THEN KEYBUF$ = LEFT$(KEYBUF$,LEN(KEYBUF$)-1)
05F8    0476            IF A$ > CHR$(31) THEN KEYBUF$ = KEYBUF$ + A$
061E    0476        WEND
0622    0476        TEMP = VAL(KEYBUF$)     'temp has value of keys input
0632    047A
0632    047A        'round off temp according to step size in menu array
40  0632    047A        TEMP = INT(TEMP / (MENU(MENUZ,3)) + .5) * MENU(MENUZ,3)
0648    047A
0648    047A        'test TEMP for maximum and minimum values in menu array
0648    047A        IF TEMP > MENU(MENUZ,1) THEN TEMP = MENU(MENUZ,1)
0666    047A        IF TEMP < MENU(MENUZ,2) THEN TEMP = MENU(MENUZ,2)
06E9    047A
45  06E9    047A        'insert new value into menu array and update screen
06E9    047A        MENU(MENUZ,0) = TEMP
0705    047A        LOCATE 25,30:PRINT SPACE$(40);
0722    047A        COLOR 0,7:GOSUB DISPMENU
0734    047A        RETURN
0738    047A
50  0738    047A    T2:     'set Burr-Brown board then print desired pattern
0730    047A
0730    047A        BEEP:COLOR 15,0:LOCATE 25,1
075A    047A        PRINT "Set Potentiometers on Printer....then Press any Key";
0767    047A        A$ = ""
0771    047A        WHILE A$ = ""
55
```

```
Offset  Data    Source Line

0780    047A            A$ = INKEY$
078A    047A        WEND
078D    047A        LOCATE 25,1:PRINT SPACE$(79);
07AA    047A
07AA    047A        'enter drop parameters into burr-brown board
07AA    047A        TEMP = MENU(0,0):CALL SET.DOT.RATE(TEMP)
07D3    047A        TEMP = 5:CALL SET.DOT.WIDTH(TEMP)
07ED    047A        TEMP = MENU(2,0):CALL SET.STROBE.DELAY(TEMP)
0819    047A        CALL DOT.ON
0825    047A
0825    047A        TEMP% = 4
082C    047C        CALL DIGITAL.OUT(TEMP%)
083C    047C        TEMP% = 0:                      'pulse RESET line
0843    047C        CALL DIGITAL.OUT(TEMP%)
0853    047C        TEMP% = 4
085A    047C        CALL DIGITAL.OUT(TEMP%)
086A    047C
086A    047C        J% = CINT(MENU(1,0) * 255 / 150): 'set pulse amplitude by pulsing HIGHER signal J% number of times
0893    047E        FOR I% = 1 TO J%
08A0    0480                TEMP% = 6:              'set HIGHER true
08A7    0480                CALL DIGITAL.OUT(TEMP%)
08B7    0480                TEMP% = 4:              'set HIGHER false
08BE    0480                CALL DIGITAL.OUT(TEMP%)
08CE    0480        NEXT I%
08E0    0482
08E0    0482        'establish COM1: and initialize plotter
08E0    0482        OPEN "COM1:2400,N,8,2,CS 65535" AS #1
08F2    0482        PRINT #1,";:UECS,E771,n";
0902    0482
0902    0482        'move nozzle offset and establish new origin
0902    0482        PRINT #1,"AO";
0912    0482
0912    0482        'calculate row/column location, move there, and set new origin
0912    0482        X% = (MENU(12,0)-1) * (MENU(14,0) / 0.005)
0954    0484        Y% = (MENU(13,0)-1) * (MENU(15,0) / 0.005)
0996    0486        PRINT #1,X%;Y%;"O";
09B4    0486
09B4    0486        'print the pattern using repeat count
09B4    0486        REPY% = MENU(8,0) / 0.005
09D7    0488        REPX% = MENU(9,0) / 0.005
09FA    048A
09FA    048A        FOR REPEAT% = 0 TO MENU(7,0)
0A1C    048C
0A1C    048C                'print the pattern
0A1C    048C                FOR CT% = 0 TO ELNUM% - 1
0A2A    0490                        ON SCNDAT%(CT%,0) GOSUB PLINE, PRECT, FSRECT, PCIRCL
0A4C    0492                NEXT CT%
0A5E    0492
0A5E    0492                PRINT #1,"A,0,0,";:     'return to origin
0A6E    0492                PRINT #1,REPX%;REPY%;"O";: 'move to next pattern
0A8C    0492        NEXT REPEAT%
0AA1    0494
0AA1    0494        PRINT #1,"H";:  'return plotter to original HOME
0AB1    0494
```

```
5   Reagest Jet Printer
    Pattern Printing

    Offset  Data    Source Line

     0A81   0494            CLOSE #1:       'disable comi:
10   0A88   0494
     0A88   0494            RETURN
     0A8C   0494
     0A8C   0494    PLINE:
     0AC1   0494            PRINT #1,SCNDATI(CTI,2);SCNDATI(CTI,1):"D";
     0B03   0494            PRINT #1,SCNDATI(CTI,4);SCNDATI(CTI,3);"U";
15   0B45   0494            RETURN
     0B49   0494
     0B49   0494    PRECT:
     0B4E   0494            PRINT #1,SCNDATI(CTI,2);SCNDATI(CTI,1);"D";
     0B90   0494            PRINT #1,SCNDATI(CTI,4);SCNDATI(CTI,1);
     0BCC   0494            PRINT #1,SCNDATI(CTI,4);SCNDATI(CTI,3);
20   0C08   0494            PRINT #1,SCNDATI(CTI,2);SCNDATI(CTI,3);
     0C44   0494            PRINT #1,SCNDATI(CTI,2);SCNDATI(CTI,1);"U";
     0C86   0494            RETURN
     0C8A   0494
     0C8A   0494    PCIRCL:
     0C8F   0494            RADIUSI = SQR((SCNDATI(CTI,3)-SCNDATI(CTI,1))^2 + (SCNDATI(CTI,4)-SCNDATI(CTI,2))^2)
25   0D1A   0496            PRINT #1,"CC ";SCNDATI(CTI,2);SCNDATI(CTI,1);RADIUSI;
     0D67   0496            RETURN
     0D67   0496
     0D67   0496    PSRECT:
     0D6C   0496            SII = SCNDATI(CTI,4):EII = SCNDATI(CTI,2)
     0DA0   0496            SYI = SCNDATI(CTI,3):EYI = SCNDATI(CTI,1)
30   0DD4   049E            IF EII <= SII THEN SII = SCNDATI(CTI,2):EII = SCNDATI(CTI,4)
     0E15   049E            IF EYI <= SYI THEN SYI = SCNDATI(CTI,1):EYI = SCNDATI(CTI,3)
     0E56   049E
     0E56   049E            PRINT #1,SII;SYI;"D";
     0E74   049E
35   0E74   049E            IF EII - SII >= EYI - SYI THEN GOSUB STEPY ELSE GOSUB STEPI
     0E9D   049E
     0E9D   049E            PRINT #1,"U";
     0EAD   049E            RETURN
     0EB1   049E
     0EB1   049E    STEPY:
40   0EB6   049E            PRINT #1,EII;SYI;
     0ECE   049E            SYI = SYI + 1
     0ED7   049E            IF SYI > EYI THEN RETURN
     0EE8   049E            PRINT #1,EII;SYI;SII;SYI;
     0F0E   049E            SYI = SYI + 1
     0F17   049E            IF SYI > EYI THEN RETURN
45   0F28   049E            PRINT #1,SII;SYI;
     0F40   049E            GOTO STEPY
     0F44   049E
     0F44   049E    STEPI:
     0F49   049E            PRINT #1,SII;EYI;
     0F61   049E            SII = SII + 1
50   0F6A   049E            IF SII > EII THEN RETURN
     0F78   049E            PRINT #1,SII;EYI;SII;SYI;
     0FA1   049E            SII = SII + 1
     0FAA   049E            IF SII > EII THEN RETURN
     0FB8   049E            PRINT #1,SII;SYI;
     0FD3   049E            GOTO STEPI
65
```

```
   Offset  Data   Source Line

   0FD7  049E
10 0FD7  049E   NEWMENU: 'write old item in yellow, point to and highlight new item
   0FDC  049E            COLOR 14,0:GOSUB DISPMENU
   0FEE  049E            MENUI = MENUI + DIFFI
   0FFA  049E            IF MENUI = 10 THEN MENUI = 9
   100C  049E            IF MENUI = 11 THEN MENUI = 9
   101E  049E            IF MENUI > 15 THEN MENUI = 15
15 1030  049E            COLOR 0,7:GOSUB DISPMENU:RETURN
   1046  049E
   1046  049E   INITIALIZE:
   1048  049E            'change to screen 0 and display messages
   1048  049E            SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,17:PRINT "Loading selected Reagent and Pattern Data Files";
   108F  049E            LOCATE 12,33:PRINT "Please Wait..."
20 10A9  049E
   10A9  049E            'initialize notepad on screen 2
   10A9  049E            SCREEN 0,0,2,1:CLS:COLOR 15
   10CE  049E            PRINT"Digital Notepad - - -All information typed here is sent to the printer"
   10DB  049E            NOTELINE1 = 3
   10E2  049E
25 10E2  049E            'initialize menu arrays
   10E2  049E            RESTORE ARRDATA
   10E9  049E            FOR II=0 TO 17
   10EF  049E                  READ MENUS(II,0),MENUS(II,1):
   111F  049E                  READ MENU(II,1),MENU(II,2),MENU(II,3),MENU(II,4)
30 1180  049E            NEXT II
   1193  049E
   1193  049E            'get default reagent file and read values
   1193  049E
   1193  049E            OPEN "READEF.RJP" FOR INPUT AS #1
   11A4  049E            INPUT #1,FILE$
35 11B6  04A2            INPUT #1,REANAME$
   11C8  04A6            CLOSE #1
   11CF  04A6
   11CF  04A6            OPEN FILE$ FOR INPUT AS #1:     'get reagent data
   11E0  04A6            INPUT #1,MENU(0,0):             'frequency
   1200  04A6            INPUT #1,MENU(1,0):             'amplitude
40 1223  04A6            INPUT #1,MENU(2,0):             'strobe delay
   1246  04A6            INPUT #1,MENU(3,0):             'pulse width
   1269  04A6            INPUT #1,MENU(4,0):             'rise time
   128C  04A6            INPUT #1,MENU(5,0):             'fall time
   12B1  04A6            CLOSE #1
   12B8  04A6
45 12B8  04A6            'get default pattern file and read values
   12B8  04A6
   12B8  04A6            OPEN "PATDEF.RJP" FOR INPUT AS #1
   12C9  04A6            INPUT #1,FILE$
   12D8  04AA            INPUT #1,PATNAME$
   12ED  04AA            CLOSE #1
50 12F4  04AA
   12F4  04AA            OPEN FILE$ FOR INPUT AS #1:     'get pattern data
   1305  04AA            INPUT #1,ELXUNI
   1317  04AA            INPUT #1,MENU(6,0):             'grid
   131A  04AA            INPUT #1,MENU(7,0):             'repeat count
   1330  04AA            INPUT #1,MENU(8,0):             'x offset
55
```

```
   Offset  Data    Source Line

    13B0   04AA          INPUT #1,MENU(9,0);              'y offset
    13A3   04AA          FOR IZ = 0 TO ELNUMI-1
    13B1   04AC                FOR JZ = 0 TO 5
    13B7   04AC                      INPUT #1,SCNDATI(IZ,JZ)
    13D8   04AC                NEXT JZ
    13EB   04AC          NEXT IZ
    13F0   04AC          CLOSE #1
    1404   04AC
    1404   04AC          'set remaining parameters in menu array
    1404   04AC
    1404   04AC          MENU(12,0) = 1:                  'row 1
    1420   04AC          MENU(13,0) = 1:                  'column 1
    143C   04AC          MENU(14,0) = 0:                  'row spacing
    1458   04AC          MENU(15,0) = 0:                  'column spacing
    1474   04AC
    1474   04AC          'change active displayed screen to screen 0 to draw and display parameters
    1474   04AC
    1474   04AC          SCREEN 0,0,0,1:CLS
    1491   04AC
    1491   04AC          COLOR 13:LOCATE 1,32:PRINT "REAGENT PRINTING";
    1492   04AC          COLOR 9
    1489   04AC          FOR I=2 TO 79
    14C3   04AC                LOCATE 3,I:PRINT CHR$(196);:LOCATE 5,I:PRINT CHR$(205);:LOCATE 18,I:PRINT CHR$(196);
    1523   0480          NEXT I
    153E   0480          FOR I=4 TO 17
    1548   0480                LOCATE 1,1:PRINT CHR$(179);:LOCATE 1,28:PRINT CHR$(186);:LOCATE 1,54:PRINT CHR$(186);:LOCATE 1,8
RINT CHR$(179);
    15C8   0480          NEXT I
    15E6   0480          RESTORE TABLE
    15ED   0480          FOR I=1 TO 12
    15F7   0480                READ R1,C1,N1:LOCATE R1,C1:PRINT CHR$(N1);
    162A   0486          NEXT I
    1645   0486
    1645   0486          'display 16 menu choices in yellow
    1645   0486
    1645   0486          COLOR 14,0
    1651   0486          FOR MENUI = 0 TO 15
    1657   0486                GOSUB DISPMENU
    1659   0486          NEXT MENUI
    1669   0486
    1669   0486          'set for first menu entry and highlight it
    1669   0486          MENUI = 0:COLOR 0,7
    1680   0486          GOSUB DISPMENU
    1686   0486
    1686   0486          'print three headings and instructions
    1686   0486          COLOR 10,0
    1692   0486          LOCATE 4,14.5-LEN(REANAME$)/2:PRINT REANAME$;
    16C1   0486          LOCATE 4,41-LEN(PATNAME$)/2:PRINT PATNAME$;
    16F0   0486          LOCATE 4,60:PRINT "PRINT LOCATION";
    170A   0486
    170A   0486          COLOR 7:LOCATE 19,20:PRINT "Use ";:COLOR 15:PRINT CHR$(27);CHR$(32);CHR$(26);
    1754   0486          PRINT CHR$(32);CHR$(24);CHR$(32);CHR$(25);:COLOR 7:PRINT " to position highlighted cursor";
    1793   0486          LOCATE 20,18:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
    17E9   0486          COLOR 7:PRINT" to scroll current value up or down";
```

```
   Offset  Data    Source Line

17FD    0486            LOCATE 21,5:PRINT "Use ";:COLOR 15:PRINT "P";:COLOR 7:PRINT " to print pattern or ";
183F    0486            COLOR 15:PRINT "E";:COLOR 7:PRINT " to exit to print menu";
1867    0486            PRINT " or ";:COLOR 15:PRINT "S";:COLOR 7:PRINT " to use notepad";
189C    0486
189C    0486            'set screen to view menu just created and exit
189C    0486
189C    0486            SCREEN 0,0,0,0
1881    0486            RETURN
1885    0486
1885    0486    DISPMENU:
188A    0486            IF MENUZ = 10 OR MENUZ = 11 THEN RETURN
18CE    0486            LOCATE (MENUZ MOD 6)*2+7,(INT(MENUZ/6)*28+2)-2*INT(MENUZ/12)
1938    0486            PRINT MENU$(MENUZ,0)
1956    0486            LOCATE (MENUZ MOD 6)*2+7,MENU(MENUZ,4)
1969    0486            PRINT USING MENU$(MENUZ,1);MENU(MENUZ,0);
1988    0486            RETURN
198F    0486    REM $PAGE
```

```
Request Jet Printer                                                    PAGE
Pattern Printing                                                       09-17
                                                                       08:49
                                                IBM Personal Computer BASIC Compiler V2

Offset  Data    Source Line

 198F   0486   '************ DATA USED BY THIS MODULE ************
 198F   0486
 198F   0486   ARRDATA:
 19C4   0486           DATA "Dot Frequency        Hz",.188,888",10000,1,1,16
 19C6   0486           DATA "Amplitude            V ","888",150.0,1,19
 19C8   0486           DATA "Strobe Delay         uS",".88,888.8",15999.5,.5..5,16
 19CA   0486           DATA "Pulse Width            ","888",999,0,1,19
 19CC   0486           DATA "Rise Time              ","888",999,0,1,19
 19CE   0486           DATA "Fall Time              ","888",999,0,1,19
 1980   0486           DATA "Grid Size          in","0.888",.005,.005,.005,45
 1982   0486           DATA "Repeat Count           ","88",99,0,1,47
 1984   0486           DATA "X Axis Offset      in","0.888",2,0,.005,45
 1986   0486           DATA "Y Axis Offset      in","0.888",2,0,.005,45
 1988   0486           DATA "","",0,0,0,0
 198A   0486           DATA "","",0,0,0,0
 198C   0486           DATA "Row to Print       ","88",99,1,1,74
 198E   0486           DATA "Column to Print    ","88",99,1,1,74
 19E0   0486           DATA "Row Spacing          in","0.888",3,0,.005,72
 19E2   0486           DATA "Column Spacing       in","0.888",3,0,.005,72
 19E4   0486           DATA "","",0,0,0,0
 19E6   0486           DATA "","",0,0,0,0
 19E8   0486
 19E8   0486   TABLE:
 19ED   0486           DATA 3,1,218
 19EF   0486           DATA 3,28,210
 19F1   0486           DATA 3,54,210
 19F3   0486           DATA 3,80,191
 19F5   0486           DATA 5,1,198
 19F7   0486           DATA 5,28,206
 19F9   0486           DATA 5,54,206
 19FB   0486           DATA 5,80,181
 19FD   0486           DATA 18,1,192
 19FF   0486           DATA 18,28,208
 1A01   0486           DATA 18,54,208
 1A03   0486           DATA 15,80,217
 1A05   0486
 1A05   0486   END SUB
 1A0C   0486
 1A0C   0486
 2049   0486

50426 Bytes Available
44716 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

0030  0006  REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Reagent Filing'
0030  0006  '
0030  0006  'MODULE    - "REAFILE" File Handling for reagents
0030  0006  '
0030  0006  'AUTHOR    - N. A. Enevold
0030  0006  '
0030  0006  'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030  0006  '
0030  0006  'REVISION - 1.1 03-07-86 NAE Added notes and description
0030  0006  '           1.0 02-14-86 NAE Creation of initial code
0030  0006  '
0030  0006  'SYSTEM    - This code can only be compiled by the BASCOM
0030  0006  '           COMPILER, it will not run under the INTERPRETER!!
0030  0006  '
0030  0006  'DESCRIPTION:
0030  0006  '       This module allow file handling for reagents.  When inv
oked, it displays
0030  0006  '       the current contents of the reagent directory in 4 colu
mns of 20 entries
0030  0006  '       each.  The reagent which is currently selected for prin
ting is marked by
0030  0006  '       an asterisk to the left of the reagent name.  After the
 directory is listed
0030  0006  '       the user is presented with 5 menu choices.  The left an
d right arrows are
0030  0006  '       used to highlight menu items and the enter key is used
to invoke action.
0030  0006  '       The menu choices and their actions are:
0030  0006  '
0030  0006  '               DELETE - Remove a reagent file from the directo
ry
0030  0006  '               COPY -   Copy a reagent file to a new reagent n
ame, saving the old reagent
0030  0006  '               RENAME - Change the name of the reagent without
 changing the reagent itself
0030  0006  '               SELECT - Selct a reagent for printing
0030  0006  '               EXIT -   Return to the main menu
0030  0006  '
0030  0006  'DATA DICTIONARY
0030  0006  '       TYPE%       Which type of valid key was pushed
0030  0006  '       MENU%       Which menu item is being pointer to (0-4)
0030  0006  '       DIFF%       Distance to move MENU% at left or right arro
w
0030  0006  '       FLAG%       Error type 0-4
0030  0006  '       POINTER%    Position of REANAME$ in directory list
0030  0006  '       REANUM%             Number of reagent names in directory
 list
0030  0006  '       TEMP%       Storage for integers during reagent copy
0030  0006  '       A$          Misc. input string
0030  0006  '       FUNCT$      Printed at bottom of screen during prompt fo
r reagent name
0030  0006  '       REANAME$    Reagent name currently being worked on
0030  0006  '       SELNAME$    Reagent name currently selected for printing
0030  0006  '       FILE$       Filename of reagent data file
0030  0006  '       SFILE$      Filename for source reagent data file used d
```

```
                        during copy
0030  0006  '       OFILE$      Filename for destination reagent data file u
sed during copy
0030  0006  '       NEWNAME$    New reagent name for COPY and RENAME
0030  0006  '       TEMP$       Reagent names are held here as the directory
 is being re-written
0030  0006  '       NEWFILE$    Destination filename used while copying reag
ent data files
0030  0006  '       MESSAGE$    A message printed at the bottom of the scree
n
0030  0006  '       MENU$(4,1) Array of strings containing the short and lo
ng menu names
0030  0006  '       ERRMSG$     Message printed when any error occurs
0030  0006  '       ERR$        Appended to ERRMSG$ to indicate nature of er
ror
0030  0006  REM $PAGE
```



```
0030  0006  SUB REAGENT.FILE STATIC
0047  0006
0047  0006          GOSUB INITIALIZE
004D  0006          TYPE1 = 0
0054  0008
0054  0008          WHILE TYPE1 <> 3
005F  0008                  A$ = ""
0069  000C                  WHILE A$ = ""
0076  000C                        A$ = INKEY$
0082  000C                  WEND
0085  000C                  IF A$ = CHR$(0) + CHR$(75) THEN TYPE1 = 1:
                      'left arrow
00AA  000C                  IF A$ = CHR$(0) + CHR$(77) THEN TYPE1 = 2:
                      'right arrow
00CF  000C                  IF A$ = CHR$(13) THEN TYPE1 = 3:
                      '(cr) to execute selection
00E9  000C
00E9  000C                  ON TYPE1 GOSUB T1, T2, T3
00F8  000C          WEND
00FC  000C
00FC  000C          EXIT SUB
0100  000C
0100  000C    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0100  000C  '******** SUB-ROUTINES FOR THIS MODULE ********
0100  000C
0100  000C  T1:         'left arrow
0105  000C          TYPE% = 0
010C  000C          IF MENU% = 0 THEN RETURN
0118  000E          DIFF% = -1
0122  0010          GOSUB NEW.MENU
0128  0010          RETURN
012C  0010
012C  0010  T2:         'right arrow
0131  0010          TYPE% = 0
013B  0010          IF MENU% = 4 THEN RETURN
0147  0010          DIFF% = 1
014E  0010          GOSUB NEW.MENU
0154  0010          RETURN
0158  0010
0158  0010  T3:         '(cr)  (execute selected menu item)
015D  0010          LOCATE 25,1:PRINT SPACE$(79);
017A  0010          ON MENU% + 1 GOSUB T3A, T3B, T3C, T3D, T3E
018F  0010          GOSUB MENU.ON
0195  0010          RETURN
0199  0010
0199  0010  REM $PAGE
```

```
Offset  Data    Source Line          ISA Personal Computer BASIC Compiler V2.00

 0199   0010    TJA:            'delete reagent
 019E   0010            TYPE% = 0
 01A5   0010            FUNCT$ = "Delete"
 01AF   0014            GOSUB GET.SOURCE
 01B5   0014            IF LEN(REANAME$) = 0 THEN RETURN
 01C7   0018            IF REANAME$ = SELNAME$ THEN FLAG% = 4:GOSUB SHOW.ERROR:
                RETURN
 01E7   001E            GOSUB SEARCH
 01ED   001E            IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 0209   0020
 0209   0020            MESSAGE$ = "Deleting " + REANAME$ + "     Please Wait..
                "
 0220   0024            GOSUB MESSAGE.ON
 0226   0024
 0226   0024                    'rewrite directory deleting REANAME$ as indicat
                ed by POINTER%
 0226   0024            KILL "READIR.OLD"
 022D   0024            NAME "READIR.RJP" AS "READIR.OLD"
 0237   0024            OPEN "READIR.OLD" FOR INPUT AS #1
 0248   0024            OPEN "READIR.RJP" FOR OUTPUT AS #2
 025A   0024
 025A   0024            INPUT #1, REANUM%
 026C   0026            REANUM% = REANUM% - 1
 0275   0026            WRITE #2,REANUM%
 0286   0026
 0286   0026            IF REANUM% = 0 THEN GOTO DIR.DONE
 0295   0026            FOR I% = 1 TO REANUM% + 1
 02A4   0028                    INPUT #1,REANAME$
 02B6   0028                    IF I% <> POINTER% THEN PRINT #2,REANAME$
 02D3   002A            NEXT I%
 02E5   002A
 02E5   002A    DIR.DONE:
 02EA   002A            CLOSE #1:CLOSE #2
 02F8   002A
 02F8   002A                    'remove data file
 02F8   002A            FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                "REA.RJP"
 031C   002E            KILL FILE$
 0323   002E
 0323   002E                    'rename remaining data files to maintain linked
                 list to directory
 0323   002E            WHILE (REANUM% + 1) > POINTER%
 0333   002E                    SFILE$ = RIGHT$(STR$(POINTER%+1),LEN(STR$(POINT
                ER%+1))-1) + "REA.RJP"
 0359   0032                    DFILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER
                %))-1) + "REA.RJP"
 037D   0036                    NAME SFILE$ AS DFILE$
 0387   0036                    POINTER% = POINTER% + 1
 0390   0036            WEND
 0393   0036
 0393   0036            GOSUB MESSAGE.OFF
 0399   0036            REANAME$ = SELNAME$
 03A3   0036            GOSUB TJDA
 03A9   0036            GOSUB DISP.DIR
```

```
Offset  Data    Source Line
 03AF   0036            RETURN
 03B3   0036
 03B3   0036    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 03B3   0036   T3B:    'copy reagent
 03B8   0036           TYPE1 = 0
 03BF   0036           IF REANUM1 = 60 THEN FLAG1 = 3:GOSUB SHOW.ERROR:RETURN
 03DB   0036           FUNCT$ = "Copy"
 03E5   0036           GOSUB GET.SOURCE
 03EB   0036           IF LEN(REANAME$) = 0 THEN RETURN
 03FD   0036           GOSUB SEARCH
 0403   0036           IF POINTER1 = 0 THEN FLAG1 = 1:GOSUB SHOW.ERROR:RETURN
 041F   0036
 041F   0036           GOSUB GET.NEW.NAME
 0425   0036           IF LEN(NEWNAME$) = 0 THEN RETURN
 0437   003A           IF LEN(NEWNAME$) > 15 THEN FLAG1 = 2:GOSUB SHOW.ERROR:R
                     ETURN
 0457   003A
 0457   003A           MESSAGE$ = "Copying " + REANAME$ + " to " + NEWNAME$ +
                      "   Please wait.."
 047C   003A           GOSUB MESSAGE.ON
 0482   003A
 0482   003A                   'add new name at end of directory
 0482   003A           KILL "READIR.OLD"
 0489   003A           NAME "READIR.RJP" AS "READIR.OLD"
 0493   003A           OPEN "READIR.OLD" FOR INPUT AS #1
 04A4   003A           OPEN "READIR.RJP" FOR OUTPUT AS #2
 04B6   003A
 04B6   003A           INPUT #1, REANUM1
 04C8   003A           REANUM1 = REANUM1 + 1
 04D1   003A           WRITE #2,REANUM1
 04E2   003A
 04E2   003A           FOR I1 = 1 TO REANUM1 - 1
 04F1   003C                   INPUT #1,TEMP$
 0503   0040                   PRINT #2,TEMP$
 0513   0040           NEXT I1
 0525   0040           PRINT #2,NEWNAME$
 0535   0040
 0535   0040           CLOSE #1:CLOSE #2
 0543   0040
 0543   0040                   'create copy of data file
 0543   0040           FILE$ = RIGHT$(STR$(POINTER1),LEN(STR$(POINTER1))-1) +
                      "REA.RJP"
 0567   0040           NEWFILE$ = RIGHT$(STR$(REANUM1),LEN(STR$(REANUM1))-1) +
                      "REA.RJP"
 058B   0044
 058B   0044           OPEN FILE$ FOR INPUT AS #1
 059C   0044           OPEN NEWFILE$ FOR OUTPUT AS #2
 05AE   0044
 05AE   0044           INPUT #1,TEMP
 05C0   0048           WRITE #2,TEMP:  'frequency
 05D0   0048           INPUT #1,TEMP
 05E2   0048           WRITE #2,TEMP:  'pulse width
 05F2   0048           INPUT #1,TEMP
 0604   0048           WRITE #2,TEMP:  'strobe delay
 0614   0048           INPUT #1,TEMP
 0626   0048           WRITE #2,TEMP:  'nozzle
 0636   0048
```

```
Offset  Data    Source Line
 0636   0048            INPUT #1,TEMP$
 0648   0048            PRINT #2,TEMP$:         'concentration
 065B   0048            INPUT #1,TEMP$
 066A   0048            PRINT #2,TEMP$:         'density
 067A   0048            INPUT #1,TEMP$
 068C   0048            PRINT #2,TEMP$:         'viscosity
 069C   0048
 069C   0048            CLOSE #1:CLOSE #2
 06AA   0048
 06AA   0048            GOSUB MESSAGE.OFF
 06B0   0048            GOSUB DISP.DIR
 06B6   0048            RETURN
 06BA   0048
 06BA   0048    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 068A   0048   TIC:    'rename reagent
 068F   0048            TYPE% = 0
 06C6   0048            FUNCT$ = "Rename"
 06D0   0048            GOSUB GET.SOURCE
 06D6   0048            IF LEN(REANAME$) = 0 THEN RETURN
 06E3   0048            GOSUB SEARCH
 06EE   0048            IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 070A   0048
 070A   0048            GOSUB GET.NEW.NAME
 0710   0048            IF LEN(NEWNAME$) = 0 THEN RETURN
 0722   0048            IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                    ETURN
 0742   0048            IF NEWNAME$ = REANAME$ THEN RETURN
 0755   0048            MESSAGE$ = "Renaming " + REANAME$ + " to " + NEWNAME$ +
                      "    Please wait.."
 077A   0048            GOSUB MESSAGE.ON
 0780   0048
 0780   0048                    'renaming reagent name in directory
 0780   0048            KILL "READIR.OLD"
 0787   0048            NAME "READIR.RJP" AS "READIR.OLD"
 0791   0048            OPEN "READIR.OLD" FOR INPUT AS #1
 07A2   0048            OPEN "READIR.RJP" FOR OUTPUT AS #2
 07B4   0048
 07B4   0048            INPUT #1, REANUM%
 07C6   0048            WRITE #2,REANUM%
 07D7   0048
 07D7   0048            FOR I% = 1 TO REANUM%
 07E4   004A                    INPUT #1,TEMP$
 07F6   004A                    IF I% <> POINTER% THEN PRINT #2,TEMP$
 0813   004A                    IF I% = POINTER% THEN PRINT #2,NEWNAME$
 0830   004A            NEXT I%
 0842   004A
 0842   004A            CLOSE #1:CLOSE #2
 0850   004A
 0850   004A            GOSUB MESSAGE.OFF
 0856   004A            IF REANAME$ = SELNAME$ THEN REANAME$ = NEWNAME$:GOSUB T
                    IDA
 0875   004A            GOSUB DISP.DIR
 087B   004A            RETURN
 087F   004A
 087F   004A    REM $PAGE
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

 087F   004A   TJD:    'select reagent for printing
 0884   004A           TYPE1 = 0
 0888   004A           FUNCT$ = "Select"
 088E   004A           GOSUB GET.SOURCE
 0895   004A           IF LEN(REANAME$(1) = 0 THEN RETURN
 0898   004A           IF REANAME$ = SELNAME$ THEN RETURN
 08A0   004A           GOSUB TJDA
 08C0   004A           GOSUB DISP.DIR
 08C6   004A           RETURN
 08CC   004A
 08D0   004A    TJDA:
 08D0   004A           GOSUB SEARCH
 08D5   004A           IF POINTER2 = 0 THEN FLAG2 = 1:GOSUB SHOW.ERROR:RETURN
 08D5   004A
 08F7   004A           MESSAGE$ = "Selecting " + REANAME$ + "     Please Wait.
                ..."
 08F7   004A           GOSUB MESSAGE.ON
 090E   004A
 0914   004A
 0914   004A                   'change entrys in reagent default file READEF.R
                JP
 0914   004A           OPEN "READEF.RJP" FOR OUTPUT AS #1
 0926   004A           FILE$ = RIGHT$(STR$(POINTER2),LEN(STR$(POINTER2))-1) +
                "REA.RJP"
 094A   004A
 094A   004A           PRINT #1,FILE$
 095A   004A           PRINT #1,REANAME$
 096A   004A
 096A   004A           CLOSE #1
 0971   004A           GOSUB MESSAGE.OFF
 0977   004A           RETURN
 097B   004A
 097B   004A    TJE:    'exit reagent filing
 0980   004A           RETURN
 0984   004A
 0984   004A    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0984   004A    SEARCH:
 0989   004A            POINTER% = 0
 0990   004A            OPEN "READIR.RJP" FOR INPUT AS #1
 09A1   004A            INPUT #1,REANUM%:'      get number of reagents in direc
                tory
 09B3   004A            IF REANUM% = 0 THEN CLOSE #1:RETURN
 09C9   004A            TEMP$ = ""
 09D3   004A            WHILE (POINTER% < REANUM%) AND (REANAME$ <> TEMP$)
 09F8   004A                    LINE INPUT #1,TEMP$
 0A06   004A                    POINTER% = POINTER% + 1
 0A11   004A            WEND
 0A14   004A            IF REANAME$ <> TEMP$ THEN POINTER% = 0
 0A2A   004A            CLOSE #1
 0A31   004A            RETURN
 0A35   004A
 0A35   004A    GET.SOURCE:
 0A3A   004A            LOCATE 25,1:COLOR 15,0:PRINT "Enter Reagent Name to "FU
                NCT$"  ";
 0A6C   004A            LINE INPUT;"",REANAME$
 0A7A   004A            LOCATE 25,1:PRINT SPACE$(79);
 0A97   004A            RETURN
 0A9B   004A
 0A9B   004A    GET.NEW.NAME:
 0AA0   004A            LOCATE 25,1:COLOR 15,0:PRINT "Enter New Reagent Name ";
 0AC6   004A            LINE INPUT;"",NEWNAME$
 0AD4   004A            LOCATE 25,1:PRINT SPACE$(79);
 0AF1   004A            RETURN
 0AF5   004A
 0AF5   004A    DISP.DIR:       'display reagent directory in 4 coluans of 20 r
                ows
                                'read selected reagent into SELNAME$
 0AFA   004A            OPEN "READEF.RJP" FOR INPUT AS #1
 0B0E   004A            INPUT #1,SELNAME$:      'read and discard data file nam
                e
 0B1D   004A            INPUT #1,SELNAME$:      'read and save reagent name
 0B2F   004A            CLOSE #1
 0B36   004A
 0B36   004A            OPEN "READIR.RJP" FOR INPUT AS #1
 0B47   004A            INPUT #1,REANUM%:'      read number of reagents
 0B5F   004A            MESSAGE$ = "Reading Reagent Directory  Please Wait"
 0B6J   004A            GOSUB MESSAGE.ON
 0B69   004A            FLAG% = 0
 0B70   004A            TEMP% = REANUM% - 1:IF REANUM% < 80 THEN TEMP% = REANUM
                %
 0B8B   004C            FOR I% = 0 TO TEMP%
 0B97   004E                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+1
 0BCA   004E                    PRINT SPACE$(18);
 0BDA   004E            NEXT I%
 0BEC   004E
 0BEC   004E            FOR I% = 0 TO REANUM% - 1
 0BFA   0050                    INPUT #1,REANAME$
 0C0C   0050                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+3
 0C3F   0050                    PRINT REANAME$;
 0C4C   0050                    IF REANAME$ = SELNAME$ THEN LOCATE (I% MOD 20)+
```

```
                    I,(INT(I%/20)*20)+1:PRINT "*";
 0C9E  0050                 NEXT I%
 0CB0  0050                 CLOSE #1
 0CB7  0050                 GOSUB MESSAGE.OFF
 0CBD  0050                 RETURN
 0CC1  0050
 0CC1  0050 *       INITIALIZE:
 0CC6  0050                 DIM MENU$(4,1)
 0CC7  0078                 MENU$(0,0) = "Delete"
 0CDF  0078                 MENU$(0,1) = "Remove a reagent file from the directory"
 0CFA  0078                 MENU$(1,0) = "Copy"
 0D15  0078                 MENU$(1,1) = "Copy a reagent file to a new reagent name
 0D2E  0078                 MENU$(2,0) = "Rename"
 0D4B  0078                 MENU$(2,1) = "Rename a reagent file in the directory"
 0D69  0078                 MENU$(3,0) = "Select"
 0D84  0078                 MENU$(3,1) = "Select a reagent file to be printed"
 0DA0  0078                 MENU$(4,0) = "Exit"
 0DB8  0078                 MENU$(4,1) = "Return to the main menu"
 0DD7  0078
 0DD7  0078                 COLOR 9,0:CLS
 0DEA  0078                 LOCATE 21,1
 0DF7  0078                 FOR I% = 1 TO 80
 0DFE  0078                       PRINT "D";
 0E0B  0078                 NEXT I%
 0E1B  0078
 0E1B  0078                 FOR MENU% = 0 TO 4
 0E21  0078                       GOSUB MENU.OFF
 0E27  0078                 NEXT MENU%
 0E37  0078
 0E37  0078                 GOSUB DISP.DIR
 0E3D  0078                 IF FLAG% ) 0 THEN GOSUB SHOW.ERROR
 0E4E  0078                 MENU% = 4
 0E55  0078                 GOSUB MENU.ON
 0E5B  0078
 0E5B  0078                 RETURN
 0E5F  0078
 0E5F  0078       NEW.MENU:
 0E64  0078                 GOSUB MENU.OFF
 0E6A  0078                 MENU% = MENU% + DIFF%
 0E76  0078                 GOSUB MENU.ON
 0E7C  0078                 RETURN
 0E80  0078
 0E80  0078       MENU.ON:
 0E85  0078                 LOCATE 22,(MENU%*10)+18
 0E9C  0078                 COLOR 0,7
 0EA8  0078                 PRINT MENU$(MENU%,0);
 0EC6  0078                 LOCATE 25,40-LEN(MENU$(MENU%,1))/2
 0EFA  0078                 COLOR 7,0
 0F06  0078                 PRINT MENU$(MENU%,1);
 0F25  0078                 RETURN
 0F29  0078
 0F29  0078       MENU.OFF:
 0F2E  0078                 LOCATE 22,(MENU%*10)+18
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
 0F45   0078            COLOR 14,0
 0F51   0078            PRINT MENU$(MENUX,0);
 0F6F   0078            LOCATE 25,40-LEN(MENU$(MENUX,1))/2
 0FA3   0078            PRINT SPACE$(LEN(MENU$(MENUX,1)));
 0FC8   0078            RETURN
 0FCC   0078
 0FCC   0078    SHOW.ERROR:
 0FD1   0078            ON FLAGX GOSUB ER1, ER2, ER3, ER4
 0FE2   0078            ERRMSG$ = ERR$ + "     Strike any key.."
 0FF2   0080            LOCATE 24,40-LEN(ERRMSG$)/2
 1014   0080            COLOR 13,0
 1020   0080            PRINT ERRMSG$;
 102D   0080            A$ = ""
 1037   0080            WHILE A$ = ""
 1046   0080                  A$ = INKEY$
 1050   0080            WEND
 1053   0080            GOSUB MESSAGE.OFF
 1059   0080            RETURN
 105D   0080
 105D   0080    ER1:
 1062   0080            ERR$ = REANAME$ + " Not Found in the Directory"
 1072   0080            RETURN
 1076   0080
 1076   0080    ER2:
 107B   0080            ERR$ = "Reagent Name is too Long (15 characters max.)"
 1085   0080            RETURN
 1089   0080
 1089   0080    ER3:
 108E   0080            ERR$ = "Directory is Full (80 reagents max.)"
 1098   0080            RETURN
 109C   0080
 109C   0080    ER4:
 10A1   0080            ERR$ = "Cannot Modify SELECTd reagent Name"
 10AB   0080            RETURN
 10AF   0080
 10AF   0080    MESSAGE.ON:
 10B4   0080            LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
                GE$;
 10EF   0080            RETURN
 10F3   0080
 10F3   0080
 10F3   0080    MESSAGE.OFF:
 10F8   0080            LOCATE 24,1:COLOR 15,0:PRINT SPACE$(79);
 1121   0080            RETURN
 1125   0080
 1125   0080    END SUB
 112C   0080
 16C9   0080

50426 Bytes Available
45718 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Offset  Data    Source Line
0030    0006    REM $TITLE:'Reagent Jet Printer  $SUBTITLE:'Pattern Filing'
0030    0006    'MODULE   - "PATFILE" File Handling for patterns
0030    0006    '
0030    0006    'AUTHOR   - N. A. Enevold
0030    0006    '
0030    0006    'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006    '
0030    0006    'REVISION - 1.0 02-12-86 NAE Creation of initial code
0030    0006    '
0030    0006    'SYSTEM   - This code can only be compiled by the BASCOM
0030    0006    '           COMPILER, it will not run under the INTERPRETER!!
0030    0006    '
0030    0006    'DESCRIPTION:
0030    0006    '       This module allow file handling for patterns.  When inv
                oked, it displays
0030    0006    '       the current contents of the pattern directory in 4 colu
                mns of 20 entries
0030    0006    '       each.  The pattern which is currently selected for prin
                ting is marked by
0030    0006    '       an asterisk to the left of the pattern name.  After the
                 directory is listed
0030    0006    '       the user is presented with 5 menu choices.  The left an
                d right arrows are
0030    0006    '       used to highlight menu items and the enter key is used
                to invoke action.
0030    0006    '       The menu choices and their actions are:
0030    0006    '
0030    0006    '               DELETE - Remove a pattern file from the directo
                ry
0030    0006    '               COPY -   Copy a pattern file to a new pattern n
                ame, saving the old pattern
0030    0006    '               RENAME - Change the name of the pattern without
                 changing the pattern itself
0030    0006    '               SELECT - Selct a pattern for printing
0030    0006    '               EXIT -   Return to the main menu
0030    0006    '
0030    0006    'DATA DICTIONARY
0030    0006    '       TYPE%       Which type of valid key was pushed
0030    0006    '       MENU%       Which menu item is being pointer to (0-4)
0030    0006    '       DIFF%       Distance to move MENU% at left or right arro
                w
0030    0006    '       FLAG%       Error type 0-4
0030    0006    '       POINTER%    Position of PATNAME$ in directory list
0030    0006    '       PATNUM%             Number of pattern names in directory
                 list
0030    0006    '       ELNUM%      Number of elements in a pattern file
0030    0006    '       TEMP%       Storage for integers during pattern copy
0030    0006    '       I%          Counter used during pattern copy
0030    0006    '       J%          Counter used during pattern copy
0030    0006    '       A$          Misc. input string
0030    0006    '       FUNCT$      Printed at bottom of screen during prompt fo
                r pattern name
0030    0006    '       PATNAME$    Pattern name currently being worked on
0030    0006    '       SELNAME$    Pattern name currently selected for printing
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

0030    0004   '       FILE$       Filename of pattern data file
0030    0006   '       SFILE$      Filename for source pattern data file used d
uring copy
0030    0008   '       DFILE$      Filename for destination pattern data file u
sed during copy
0030    000A   '       NEWNAME$    New pattern name for COPY and RENAME
0030    000C   '       TEMP$       Pattern names are held here as the directory
 is being re-written
0030    000E   '       NEWFILE$    Destination filename used while copying patt
ern data files
0030    0010   '       MESSAGE$    A message printed at the bottom of the scree
n
0030    0012   '       MENU$(4,1) Array of strings containing the short and lo
ng menu names
0030    0016   '       ERRMSG$     Message printed when any error occurs
0030    0018   '       ERR$        Appended to ERRMSG$ to indicate nature of er
ror
0030    001A   '       TEMP        Storage of real variables while copying patt
ern data files
0030    001C   REM $PAGE
```



```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

0030    0006   SUB PATTERN.FILE STATIC

0047    0006
0047    0006           GOSUB INITIALIZE
004D    0006           TYPE% = 0
0054    0008
0054    0008           WHILE TYPE% <> 3
005F    0008                   A$ = ""
0069    000C                   WHILE A$ = ""
0078    000C                           A$ = INKEY$
0082    000C                   WEND
0085    000C                   IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 1:
 'left arrow
00AA    000C                   IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 2:
 'right arrow
00CF    000C                   IF A$ = CHR$(13) THEN TYPE% = 3:
 '(cr) to execute selection
00E9    000C
00E9    000C                   ON TYPE% GOSUB T1, T2, T3
00F8    000C           WEND
00FC    000C
00FC    000C           EXIT SUB
0100    000C
0100    000C   REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0100  000C  '******** SUB-ROUTINES FOR THIS MODULE ********
0100  000C
0100  000C  T1:             'left arrow
0105  000C          TYPE% = 0
010C  000C          IF MENU% = 0 THEN RETURN
011B  000E          DIFF% = -1
0122  0010          GOSUB NEW.MENU
0128  0010          RETURN
012C  0010
012C  0010  T2:             'right arrow
0131  0010          TYPE% = 0
0138  0010          IF MENU% = 4 THEN RETURN
0147  0010          DIFF% = 1
014E  0010          GOSUB NEW.MENU
0154  0010          RETURN
0158  0010
0158  0010  T3:             '<cr>  (execute selected menu item)
015D  0010          LOCATE 25,1:PRINT SPACE$(79);
017A  0010          ON MENU% + 1 GOSUB T3A, T3B, T3C, T3D, T3E
018F  0010          GOSUB MENU.ON
0195  0010          RETURN
0199  0010
0199  0010  REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0197   0010   T3A:            delete pattern
 019E   0010          TYPE% = 0
 01A5   0010          FUNCT$ = "Delete"
 01AF   0014          GOSUB GET.SOURCE
 01B5   0014          IF LEN(PATNAME$) = 0 THEN RETURN
 01C7   0018          IF PATNAME$ = SELNAME$ THEN FLAG% = 4:GOSUB SHOW.ERROR:
                    RETURN
 01E7   001E          GOSUB SEARCH
 01ED   001E          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 0209   0020
 0209   0020          MESSAGE$ = "Deleting " + PATNAME$ + "     Please Wait..
                    "
 0220   0024          GOSUB MESSAGE.ON
 0226   0024
 0226   0024                  'rewrite directory deleting PATNAME$ as indicat
                    ed by POINTER%
 0226   0024          KILL "PATDIR.OLD"
 022D   0024          NAME "PATDIR.RJP" AS "PATDIR.OLD"
 0237   0024          OPEN "PATDIR.OLD" FOR INPUT AS #1
 0248   0024          OPEN "PATDIR.RJP" FOR OUTPUT AS #2
 025A   0024
 025A   0024          INPUT #1, PATNUM%
 026C   0026          PATNUM% = PATNUM% - 1
 0275   0026          WRITE #2,PATNUM%
 0286   0026
 0286   0026          IF PATNUM% = 0 THEN GOTO DIR.DONE
 0295   0026          FOR I% = 1 TO PATNUM% + 1
 02A4   002B                  INPUT #1,PATNAME$
 02B6   002B                  IF I% <> POINTER% THEN PRINT #2,PATNAME$
 02D3   002A          NEXT I%
 02E5   002A
 02E5   002A    DIR.DONE:
 02EA   002A          CLOSE #1:CLOSE #2
 02F8   002A
 02F8   002A                  'remove data file
 02F8   002A          FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                    "PAT.RJP"
 031C   002E          KILL FILE$
 0323   002E
 0323   002E                  'rename remaining data files to maintain linked
                     list with directory
 0323   002E          WHILE (PATNUM% + 1) > POINTER%
 0333   002E                  SFILE$ = RIGHT$(STR$(POINTER%+1),LEN(STR$(POINT
                    ER%+1))-1) + "PAT.RJP"
 0359   0032                  DFILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER
                    %))-1) + "PAT.RJP"
 0370   0036                  NAME SFILE$ AS DFILE$
 0387   0036                  POINTER% = POINTER% + 1
 039C   0036          WEND
 0393   0036
 0393   0036          GOSUB MESSAGE.OFF
 0399   0036          PATNAME$ = SELNAME$
 03A3   0036          GOSUB T3DA
 03A9   0036          GOSUB DISP.DIR
```

```
Offset  Data    Source Line
 03AF   0036            RETURN
 03B3   0036
 03B3   0036    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0383  0036  TEST:   'copy pattern
0386  0036          TYPE% = 0
038F  0036          IF PATNUM% = 80 THEN FLAG% = 3:GOSUB SHOW.ERROR:RETURN
03DE  0036          FUNCT$ = "Copy"
03E5  0036          GOSUB GET.SOURCE
03EB  0036          IF LEN(PATNAME$) = 0 THEN RETURN
03F3  0036          GOSUB SEARCH
0403  0036          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
041F  0036
041F  0036          GOSUB GET.NEW.NAME
0425  0036          IF LEN(NEWNAME$) = 0 THEN RETURN
0437  003A          IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                  ETURN
0457  003A
0457  003A          MESSAGE$ = "Copying " + PATNAME$ + " to " + NEWNAME$ +
                  "   Please wait.."
047C  003A          GOSUB MESSAGE.ON
0482  003A
0482  003A                  'add NEWNAME$ at end of directory
0482  003A          KILL "PATDIR.OLD"
0489  003A          NAME "PATDIR.RJP" AS "PATDIR.OLD"
0493  003A          OPEN "PATDIR.OLD" FOR INPUT AS #1
04A4  003A          OPEN "PATDIR.RJP" FOR OUTPUT AS #2
04B6  003A
04B6  003A          INPUT #1, PATNUM%
04C8  003A          PATNUM% = PATNUM% + 1
04D1  003A          WRITE #2,PATNUM%
04E2  003A
04E2  003A          FOR I% = 1 TO PATNUM% - 1
04F1  003C                  INPUT #1,TEMP$
0503  0040                  PRINT #2,TEMP$
0513  0040          NEXT I%
0525  0040          PRINT #2,NEWNAME$
0535  0040
0535  0040          CLOSE #1:CLOSE #2
0543  0040
0543  0040                  'create copy of pattern data file
0543  0040          FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                  "PAT.RJP"
0567  0040          NEWFILE$ = RIGHT$(STR$(PATNUM%),LEN(STR$(PATNUM%))-1) +
                  "PAT.RJP"
0588  0044
0588  0044          OPEN FILE$ FOR INPUT AS #1
059C  0044          OPEN NEWFILE$ FOR OUTPUT AS #2
05AE  0044
05AE  0044          INPUT #1,ELNUM%
05C0  0046          WRITE #2,ELNUM%
05D1  0046
05D1  0046          FOR I% = 1 TO 4
05D8  0046                  INPUT #1,TEMP
05EA  004A                  WRITE #2,TEMP
05FA  004A          NEXT I%
060A  004A
060A  004A          FOR I% = 1 TO ELNUM%
```

```
Offset  Data    Source Line
0617    004C                    FOR JZ = 1 TO 6
061E    004C                            INPUT #1,TEMPZ
0630    004E                            WRITE #2,TEMPZ
0641    004E                    NEXT JZ
0651    0050            NEXT IZ
0663    0050
0663    0050            CLOSE #1:CLOSE #2
0671    0050
0671    0050            GOSUB MESSAGE.OFF
0677    0050            GOSUB DISP.DIR
067D    0050            RETURN
0681    0050
0681    0050    T3C:            'rename pattern
0686    0050            TYPEZ = 0
068D    0050            FUNCT$ = "Rename"     -
0697    0050            GOSUB GET.SOURCE
069D    0050            IF LEN(PATNAME$) = 0 THEN RETURN
06AF    0050            GOSUB SEARCH
06B5    0050            IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
06D1    0050
06D1    0050            GOSUB GET.NEW.NAME
06D7    0050            IF LEN(NEWNAME$) = 0 THEN RETURN
06E9    0050            IF LEN(NEWNAME$) ) 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
                ETURN
0709    0050            IF NEWNAME$ = PATNAME$ THEN RETURN
071C    0050
071C    0050            MESSAGE$ = "Renaming " + PATNAME$ + " to " + NEWNAME$ +
                 "    Please wait.."
0741    0050            GOSUB MESSAGE.ON
0747    0050
0747    0050                    'change pattern name in directory replacing PAT
                NAME$ with NEWNAME$
0747    0050            KILL "PATDIR.OLD"
074E    0050            NAME "PATDIR.RJP" AS "PATDIR.OLD"
0756    0050            OPEN "PATDIR.OLD" FOR INPUT AS #1
0769    0050            OPEN "PATDIR.RJP" FOR OUTPUT AS #2
077B    0050
077B    0050            INPUT #1, PATNUMZ
078D    0050            WRITE #2,PATNUMZ
079E    0050
079E    0050            FOR IZ = 1 TO PATNUMZ
07AB    0052                    INPUT #1,TEMP$
078D    0052                    IF IZ <> POINTERZ THEN PRINT #2,TEMP$
07DA    0052                    IF IZ = POINTERZ THEN PRINT #2,NEWNAME$
07F7    0052            NEXT IZ
0809    0052
0809    0052            CLOSE #1:CLOSE #2
0817    0052
0817    0052            GOSUB MESSAGE.OFF
081D    0052
081D    0052                    'select new pattern name if necessary
0810    0052            IF PATNAME$ = SELNAME$ THEN PATNAME$ = NEWNAME$:GOSUB T
                3DA
083C    0052            GOSUB DISP.DIR
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0842   0052            RETURN
 0846   0052
 0846   0052    REM $PAGE
```



```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0846   0052    TJD:            'select pattern for printing
 084B   0052            TYPE% = 0
 0852   0052            FUNCT$ = "Select"
 085C   0052            GOSUB GET.SOURCE
 0862   0052            IF LEN(PATNAME$) = 0 THEN RETURN
 0874   0052            IF PATNAME$ = SELNAME$ THEN RETURN
 0887   0052            GOSUB TJDA
 088D   0052            GOSUB DISP.DIR
 0893   0052            RETURN
 0897   0052
 0897   0052    TJDA:
 089C   0052            GOSUB SEARCH
 08A2   0052            IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 088E   0052
 088E   0052            MESSAGE$ = "Selecting " + PATNAME$ + "     Please Wait.
..."
 08D5   0052            GOSUB MESSAGE.ON
 08DB   0052
 08DB   0052                    'change entrys in pattern default file PATDEF.R
JP
 08DB   0052            OPEN "PATDEF.RJP" FOR OUTPUT AS #1
 08ED   0052            FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
"PAT.RJP"
 0911   0052
 0911   0052            PRINT #1,FILE$
 0921   0052            PRINT #1,PATNAME$
 0931   0052
 0931   0052            CLOSE #1
 0938   0052            GOSUB MESSAGE.OFF
 093E   0052            RETURN
 0942   0052
 0942   0052    TJE:    'exit pattern filing
 0947   0052            RETURN
 094B   0052
 094B   0052    REM $PAGE
```

```
Offset  Data    Source Line
 0948   0052   SEARCH:
 0950   0052          POINTER% = 0
 0957   0052          OPEN "PATDIR.RJP" FOR INPUT AS #1
 0968   0052          INPUT #1,PATNUM%:'      get number of patterns in direc
                tory
 097A   0052          IF PATNUM% = 0 THEN CLOSE #1:RETURN
 0990   0052          TEMP$ = ""
 099A   0052          WHILE (POINTER% < PATNUM%) AND (PATNAME$ <> TEMP$)
 09C2   0052                LINE INPUT #1,TEMP$
 09CF   0052                POINTER% = POINTER% + 1
 09D8   0052          WEND
 09DB   0052          IF PATNAME$ <> TEMP$ THEN POINTER% = 0
 09F1   0052          CLOSE #1
 09F8   0052          RETURN
 09FC   0052
 09FC   0052   GET.SOURCE:
 0A01   0052          LOCATE 25,1:COLOR 15,0:PRINT "Enter Pattern Name to "FU
                NCT$" ";
 0A33   0052          LINE INPUT;"",PATNAME$
 0A41   0052          LOCATE 25,1:PRINT SPACE$(79);
 0A5E   0052          RETURN
 0A62   0052
 0A62   0052   GET.NEW.NAME:
 0A67   0052          LOCATE 25,1:COLOR 15,0:PRINT "Enter New Pattern Name ";
 0A8D   0052          LINE INPUT;"",NEWNAME$
 0A9B   0052          LOCATE 25,1:PRINT SPACE$(79);
 0AB8   0052          RETURN
 0ABC   0052
 0ABC   0052   DISP.DIR:       'display directory in 4 columns, 20 rows
 0AC1   0052                   'read default pattern name into SELNAME$
 0AC1   0052          OPEN "PATDEF.RJP" FOR INPUT AS #1
 0AD2   0052          INPUT #1,SELNAME$:      'discard data file name
 0AE4   0052          INPUT #1,SELNAME$
 0AF6   0052          CLOSE #1
 0AFD   0052
 0AFD   0052          OPEN "PATDIR.RJP" FOR INPUT AS #1
 0B0E   0052          INPUT #1,PATNUM%:'      read number of patterns
 0B20   0052
 0B20   0052          MESSAGE$ = "Reading Pattern Directory  Please Wait"
 0B2A   0052          GOSUB MESSAGE.ON
 0B30   0052          FLAG% = 0
 0B37   0052          TEMP% = PATNUM% - 1:IF PATNUM% < 80 THEN TEMP% = PATNUM
                %
 0B52   0052          FOR I% = 0 TO TEMP%
 0B5E   0054                LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+1
 0B91   0054                PRINT SPACE$(18);
 0BA1   0054          NEXT I%
 0BB3   0054
 0BB3   0054          FOR I% = 0 TO PATNUM% - 1
 0BC1   0056                INPUT #1,PATNAME$
 0BD3   0056                LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+3
 0C06   0056                PRINT PATNAME$;
 0C13   0056                IF PATNAME$ = SELNAME$ THEN LOCATE (I% MOD 20)+
                1,(INT(I%/20)*20)+1:PRINT "*";
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0C62   0056           NEXT I%
 0C77   0056           CLOSE #1
 0C7E   0056           GOSUB MESSAGE.OFF
 0C84   0056           RETURN
 0C86   0056
 0C88   0056    INITIALIZE:
 0C8D   0056           DIM MENU$(4,1)
 0C8E   007E           MENU$(0,0) = "Delete"
 0CA6   007E           MENU$(0,1) = "Remove a pattern file from the directory"
 0CC1   007E           MENU$(1,0) = "Copy"
 0CDC   007E           MENU$(1,1) = "Copy a pattern file to a new pattern name
                       "
 0CF5   007E           MENU$(2,0) = "Rename"
 0D12   007E           MENU$(2,1) = "Rename a pattern file in the directory"
 0D30   007E           MENU$(3,0) = "Select" _
 0D48   007E           MENU$(3,1) = "Select a pattern file to be printed"
 0D67   007E           MENU$(4,0) = "Exit"
 0D82   007E           MENU$(4,1) = "Return to the main menu"
 0D9E   007E
 0D9E   007E           COLOR 9,0:CLS
 0DB1   007E           LOCATE 21,1
 0DBE   007E           FOR I% = 1 TO 80
 0DC5   007E                  PRINT "D";
 0DD2   007E           NEXT I%
 0DE2   007E
 0DE2   007E           FOR MENU% = 0 TO 4
 0DE8   007E                  GOSUB MENU.OFF
 0DEE   007E           NEXT MENU%
 0DFE   007E
 0DFE   007E           GOSUB DISP.DIR
 0E04   007E           IF FLAG% > 0 THEN GOSUB SHOW.ERROR
 0E15   007E           MENU% = 4
 0E1C   007E           GOSUB MENU.ON
 0E22   007E
 0E22   007E           RETURN
 0E26   007E
 0E26   007E    NEW.MENU:
 0E2B   007E           GOSUB MENU.OFF
 0E31   007E           MENU% = MENU% + DIFF%
 0E3D   007E           GOSUB MENU.ON
 0E43   007E           RETURN
 0E47   007E
 0E47   007E    MENU.ON:
 0E4C   007E           LOCATE 22,(MENU%*10)+18
 0E63   007E           COLOR 0,7
 0E6F   007E           PRINT MENU$(MENU%,0);
 0EBD   007E           LOCATE 25,40-LEN(MENU$(MENU%,1))/2
 0EC1   007E           COLOR 7,0
 0EC9   007E           PRINT MENU$(MENU%,1);
 0EEC   007E           RETURN
 0EF0   007E
 0EF0   007E    MENU.OFF:
 0EF5   007E           LOCATE 22,(MENU%*10)+18
 0F0C   007E           COLOR 14,0
```

```
Offset  Data    Source Line
0F18    007E            PRINT MENU$(MENUZ,0);
0F36    007E            LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
0F6A    007E            PRINT SPACE$(LEN(MENU$(MENUZ,1)));
0F8F    007E            RETURN
0F93    007E
0F93    007E    SHOW.ERROR:
0F98    007E            ON FLAG% GOSUB ER1, ER2, ER3, ER4
0FA9    007E            ERRMSG$ = ERR$ + "     Strike any key.."
0FB9    0086            LOCATE 24,40-LEN(ERRMSG$)/2
0FDB    0086            COLOR 13,0
0FE7    0086            PRINT ERRMSG$;
0FF4    0086            A$ = ""
0FFE    0086            WHILE A$ = ""
100D    0086                  A$ = INKEY$
1017    0086            WEND
101A    0086            GOSUB MESSAGE.OFF
1020    0086            RETURN
1024    0086
1024    0086    ER1:
1029    0086            ERR$ = PATNAME$ + " Not Found in the Directory"
1039    0086            RETURN
1030    0086
1030    0086    ER2:
1042    0086            ERR$ = "Pattern Name is too Long (15 characters max.)"
104C    0086            RETURN
1050    0086
1050    0086    ER3:
1055    0086            ERR$ = "Directory is Full (80 patterns max.)"
105F    0086            RETURN
1063    0086
1063    0086    ER4:
1068    0086            ERR$ = "Cannot Modify SELECTd pattern Name"
1072    0086            RETURN
1076    0086
1076    0086    MESSAGE.ON:
1078    0086            LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
                        GE$;
1086    0086            RETURN
108A    0086
108A    0086
108A    0086    MESSAGE.OFF:
108F    0086            LOCATE 24,1:COLOR 15,0:PRINT SPACE$(79);
10EB    0086            RETURN
10EC    0086
10EC    0086    END SUB
10F3    0086
1688    0086

50426 Bytes Available
45670 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
0030    0006    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Main Line Code'
0030    0006
0030    0006    'MODULE   - "MAIN"
0030    0006
0030    0006    'AUTHOR   - W. A. Enevold
0030    0006
0030    0006    'COPYRIGHT (C) 1986 ABBOTT LABORATORIES
0030    0006
0030    0006    'REVISION - 1.1 02-19-86 NAE Add notes and revise TYPE% resetin
                g
0030    0006    '         - 1.0 02-14-86 NAE Creation of initial code
0030    0006
0030    0006    'SYSTEM   - This code can only be compiled by the BASCOM
0030    0006    '           COMPILER, it will not run under the INTERPRETER!!
0030    0006
0030    0006    'DESCRIPTION
0030    0006    '       This is the main controlling module for the Reagent Jet
                 Printer.
0030    0006    '       It displays a menu in table form that allows 6 function
                s to be
0030    0006    '       selected.  PATTERN DEFINITION allows the user to define
                 patterns
0030    0006    '       to be printed.  PATTERN FILING lets the user delete, co
                py, rename
0030    0006    '       and select patterns for printing.  REAGENT CALIBRATION
                permits setting
0030    0006    '       of operation parameters for different reagents.  REAGEN
                T FILING is
0030    0006    '       the same as pattern filing.  PRINTING PRINT prints the
                selected
0030    0006    '       pattern with the selected reagent.  SYSTEM EXIT TO DOS
                ends the session.
0030    0006    '       Using up and down arrow keys let the user move through
                the menu and
0030    0006    '       the Enter (cr) key activates the selection.
0030    0006
0030    0006    'DATA DICTIONARY
0030    0006    '       MENU%           This value represents the current menu
                item (0-5)
0030    0006    '       MENU$(5,1)      String array for displaying menu items.
                  6 rows by 2 columns
0030    0006    '                       Each row corresponds to a menu item (0-
                5)
0030    0006    '                       First column is short menu name in high
                lighted area
0030    0006    '                       Second column is long description displ
                ayed at menu bottom
0030    0006    '       MROW%(5)        This array stores to row in which the s
                hort menu name will be displayed
0030    0006    '       DIFF%           This value is used it change MENU% in r
                esponse to arrow keys
0030    0006    '       TYPE%           This value is set based on which valid
                key is pressed
0030    0006    '                       0 = No valid key.  1 = Up Arrow.  2 = D
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
                own Arrow.  3 = (cr).
0030  0006    '       TEMP%           Used to store MENU% while screen is ref
reshed
0030  0006    '       A$              Used to store single input keystrokes
0030  0006    '       C$              Used to store special graphics characte
rs used in drawing the menu table
0030  0006    '       I%              Counter used to refresh display
0030  0006    '       R%              Row in which special graphics character
 is dislayed
0030  0006    '       C%              Column in which special graphics charac
ter is displayed
0030  0006    REM $PAGE
```


Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030  0006
0030  0006    'Main-line code for RJP Reagent Jet Printer
0030  0006
0030  0006    MAIN.LINE.CODE:
0030  0006
0030  0006            GOSUB INITIALIZE
0043  0006
0046  0006            WHILE TYPE% <> 3
0056  0008
0056  0008                    TYPE% = 0
005D  0008                    A$ = ""
0067  000C                    WHILE A$ = ""
0076  000C                            A$ = INKEY$
0080  000C                    WEND
0083  000C
0083  000C                    IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 1:'
up arrow
0098  000C                    IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 2:'
down arrow
00CD  000C                    IF A$ = CHR$(13) THEN TYPE% = 3:'
(cr) execute command
00E7  000C
00E7  000C                    ON TYPE% GOSUB T1, T2, T3
00F6  000C
00F6  000C            WEND
00FA  000C
00FA  000C            CLS
0101  000C            COLOR 7,0,0
0112  000C            SYSTEM
0116  000C
0116  000C    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0116   000C    '******** SUB-ROUTINES FOR MAIN PROGRAM
 0116   000C    T1:     'up arrow
 0118   000C            IF MENU% = 0 THEN RETURN
 012A   000E            DIFF% = -1
 0131   0010            GOSUB NEW.MENU
 0137   0010            RETURN
 013B   0010
 013B   0010    T2:     'down arrow
 0140   0010            IF MENU% = 5 THEN RETURN
 014F   0010            DIFF% = 1
 0156   0010            GOSUB NEW.MENU
 015C   0010            RETURN
 0160   0010
 0160   0010    T3:
 0163   0010            ON MENU% + 1 GOSUB T31, T32, T33, T34, T35, T36
 017C   0010            IF MENU% < 5 THEN TYPE% = 0:'   reset TYPE% so progra
                    won't end
 013E   0010            SCREEN 0,0,3,3
 01A5   0010            RETURN
 01A9   0010
 01A9   0010    T31:    'pattern definition
 01AE   0010            CALL PATENTRY:          'in module PATENT
 01BA   0010            GOSUB REFRESH
 01C0   0010            RETURN
 01C4   0010
 01C4   0010    T32:    'pattern filing
 01C9   0010            SCREEN 0,0,0,0:CLS
 01E5   0010            CALL PATTERN.FILE:      'in module PATFILE
 01F1   0010            RETURN
 01F5   0010
 01F5   0010    T33:    'reagent calibration
 01FA   0010            CALL REAGENT.CALIBRATE:'in module REACAL
 0206   0010            RETURN
 020A   0010
 020A   0010    T34:    'reagent filing menu
 020F   0010            SCREEN 0,0,0,0:CLS
 022B   0010            CALL REAGENT.FILE:      'in module REAFILE
 0237   0010            RETURN
 023B   0010
 023B   0010    T35:    'print pattern
 0240   0010            CALL PATPRINT:          'in module PATPRINT
 024C   0010            RETURN
 0250   0010
 0250   0010    T36:    'exit system, don't reset TYPE%
 0255   0010            RETURN
 0259   0010
 0259   0010    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0259  0010  NEW.MENU:
025E  0010          GOSUB MENU.OFF
0264  0010          MENUZ = MENUZ + DIFFZ
0270  0010          GOSUB MENU.ON
0276  0010          RETURN
027A  0010
027A  0010  INITIALIZE:
027F  0010          CALL PCI.INIT
028B  0010
028B  0010          define and initialize arrays
028B  0010          DIM MROWZ(5)
028C  001C          MROWZ(0) = 4
029E  001C          MROWZ(1) = 6
02B1  001C          MROWZ(2) = 10
02C4  001C          MROWZ(3) = 12
02D7  001C          MROWZ(4) = 16
02EA  001C          MROWZ(5) = 20
02FD  001C
02FD  001C          DIM MENU$(5,1)
02FE  004C          RESTORE MENU.STRING.DATA
0305  004C          FOR IZ = 0 TO 5
0308  004C                READ MENU$(IZ,0),MENU$(IZ,1)
033B  004E          NEXT IZ
034B  004E
034B  004E          set initial values into variables
034B  004E          TYPEZ = 0
0352  004E          MENUZ = 0
0359  004E
0359  004E  REFRESH: 'redraw screen and highlight current menu selection
035E  004E
035E  004E          SCREEN 0,0,0,0:CLS:COLOR 7,0,0
038B  004E          LOCATE 10,32:PRINT "Loading Menu....."
03A5  004E          SCREEN 0,0,3,0:CLS
03C2  004E
03C2  004E
03C2  004E          COLOR 13,0
03CE  004E          LOCATE 1,31
03DB  004E          PRINT "REAGENT JET PRINTER";
03E8  004E          COLOR 10,0
03F4  004E          LOCATE 5,26
0401  004E          PRINT "PATTERN"
040E  004E          LOCATE 11,26
041B  004E          PRINT "REAGENT"
0428  004E          LOCATE 16,26
0435  004E          PRINT "PRINTING"
0442  004E          LOCATE 20,27
044F  004E          PRINT "SYSTEM"
045C  004E
045C  004E          draw the menu table in special graphics characters
045C  004E          COLOR 9,0
0466  004E          FOR IZ = 18 TO 62
046F  004E                LOCATE 2,IZ:PRINT "D";
048A  004E                LOCATE 8,IZ:PRINT "D";
04A5  004E                LOCATE 14,IZ:PRINT "D";
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
                
04C0    004E                LOCATE 18,IX:PRINT "D";
04DB    004E                LOCATE 22,IX:PRINT "D";
04F6    004E                LOCATE 24,IX:PRINT "D";
0511    004E            NEXT IX
0524    004E            FOR IX = 3 TO 23
052B    004E                LOCATE IX,17:PRINT "J";
0546    004E                LOCATE IX,64:PRINT "J";
0561    004E            NEXT IX
0571    004E            RESTORE TABLE
0578    004E            FOR IX = 1 TO 12
057F    004E                READ RX,CX,C$
0592    0056                LOCATE RX,CX:PRINT C$;
05AE    0056            NEXT IX
05BE    0056
05BE    0056        '   print the instructions
05BE    0056            COLOR 7,0
05CA    0056            LOCATE 25,6
05D7    0056            PRINT "Use   or   to highlight menu items.  Use     to
                activate selection.";
05E4    0056
05E4    0056            COLOR 15,0
";
060A    0056            LOCATE 25,15:PRINT "";
0624    0056            LOCATE 25,47:PRINT "DY";
063E    0056
063E    0056        '   display the 6 menu choices
063E    0056            TEMPX = MENUX
0645    0058            FOR MENUX = 0 TO 5
064B    0058                GOSUB MENU.OFF
0651    0058            NEXT MENUX
0661    0058            MENUX = TEMPX
0668    0058
0668    0058        '   highlight the currently active menu item
0668    0058            GOSUB MENU.ON
066E    0058
066E    0058            SCREEN 0,0,3,3
0685    0058            RETURN
0689    0058
0689    0058    MENU.ON:'highlight the menu MENUX and display its long descript
                ion
068E    0058            COLOR 0,7
069A    0058            LOCATE ARROWX(MENUX),52-LEN(MENUS(MENUX,0))/2
06DA    0058            PRINT MENUS(MENUX,0);
06F6    0058            COLOR 7,0
0704    0058            LOCATE 23,40.5-LEN(MENUS(MENUX,1))/2
0738    0058            PRINT MENUS(MENUX,1);
0757    0058            RETURN
0758    0058
0758    0058    MENU.OFF:'un-highlight menu MENUX and erase long description
0760    0058            COLOR 14,0
076C    0058            LOCATE ARROWX(MENUX),52-LEN(MENUS(MENUX,0))/2
07AC    0058            PRINT MENUS(MENUX,0);
07CA    0058            COLOR 7,0
07D6    0058            LOCATE 23,40.5-LEN(MENUS(MENUX,1))/2
```

Reagent Jet Printer
Main Line Code

IBM Personal Computer BASIC Compiler V2.00

```
Offset  Data    Source Line
 060A   0058            PRINT SPACE$(LEN(MENU$(MENUZ,I)));
 062F   0058            RETURN
 0833   0058
 0833   0058    REM SPACE
```

```
Reagent Jet Printer                                              PAGE  6
Main Line Code                                                   07-09-86
                                                                 15:27:04
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0833    0058    '******** DATA FIELDS USED BY THE MAIN PROGRAM ********
0833    0058
0833    0058    MENU.STRING.DATA:       'first entry is menu name, second is lo
                ng description
0838    0058
0838    0058            DATA "DEFINITION", "Create and Modify Patterns"
083A    0058            DATA "FILING",     "Delete, Copy, Rename, and Select Pa
                tterns"
083C    0058            DATA "CALIBRATION","Calibrate and Modify Reagent Profil
                es"
083E    0058            DATA "FILING",     "Delete, Copy, Rename, and Select Re
                agents"
0840    0058            DATA "PRINT",      "Print Selected Pattern with Selecte
                d Reagent"
0842    0058            DATA "EXIT TO DOS","Leave Program and Return to DOS"
0844    0058
0844    0058    TABLE:  'first entry is row, second is column, third is special
                 graphics character
0849    0058
0849    0058            DATA 2,17,"Z"
0848    0058            DATA 2,64,"?"
084D    0058            DATA 8,17,"C"
084F    0058            DATA 8,64,"4"
0851    0058            DATA 14,17,"C"
0853    0058            DATA 14,64,"4"
0855    0058            DATA 18,17,"C"
0857    0058            DATA 18,64,"4"
0859    0058            DATA 22,17,"C"
085B    0058            DATA 22,64,"4"
085D    0058            DATA 24,17,"B"
085F    0058            DATA 24,64,"Y"
0861    0058
0861    0058            END
0865    0058
0842    0058

50476 Bytes Available
47680 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

Claims

1. A dispensing system for use in diagnostic instruments for precise metering of a desired diagnostic fluid, the system comprising:
a jetting chamber defining a volume and comprising a first and s cond aperture, the first aperture adapted to rec ive diagnostic fluid, the second aperture defining an orifice:
a transducer in m chanical communication with the jetting chamber, the transducer operative to alternately expand and de-expand the volume of the j tting chamber in response to a selected electrical puls and

thereby cause the jetting chamber to omit a substantially uniformly sized droplet of diagnostic fluid through the orifice; and

means for generating a number of electrical pulses sufficient to cause a desired quantity of the diagnostic fluid to be dispensed.

2. The invention of Claim 1 wherein the system further comprises:

at least one additional jetting chamber in fluid communication with an additional diagnostic fluid;

at least one additional transducer in mechanical communication with the additional jetting chamber;

at least one additional means for applying an electrical pulse to the additional transducer;

means for generating respective numbers of electrical pulses sufficient to cause precise quantities of the diagnostic fluids to be dispensed in a desired volumetric ratio; and

a receptacle adapted for and positioned to receive the fluids.

3. The invention of Claim 1 wherein the system further comprises:

means for directing at least one of (1) the receptacle and (2) the emitted diagnostic fluid and the emitted addi-tional diagnostic fluid such that desired quantities of the fluids are dispensed into the receptacle in a predefined dispensing order.

4. The invention of Claim 1 wherein one of the diagnostic fluids comprises serum and wherein the jetting chambers cooperate such that the other diagnostic fluid is emitted in a manner to contact and mix with the serum.

5. The invention of Claim 1 wherein the jetting chamber comprises a cylindrical tube and wherein the trans-ducer is mounted concentrically about the cylindrical tube.

6. The invention of Claim 1 wherein the jetting chamber is conically shaped.

7. The invention of Claim 1 wherein the jetting chamber comprises at least one chamber wall which is integrally formed with the transducer.

8. The invention of Claim 1 wherein the transducer is one of (1) a piezo-electric transducer; (2) a magneto-strictive transducer; (3) an electro-strictive transducer; and (4) an electro-mechanical transducer.

9. The invention of Claim 1 wherein the jetting chamber is conically shaped; and wherein the transducer is disc shaped and forms the base of the conically shaped jetting chamber.

10. The invention of Claim 1 wherein the orifice comprises an end face and the end face is coated with a hydrophobic polymer.

11. The invention of Claim 1 wherein the transducer is cylindrically shaped and comprises a first electrode located on the inner wall of the cylinder and wraps around one end of the cylinder and wherein a second electrode is located substantially on the outer wall of the cylinder and is electrically isolated from the first electrode.

12. The invention of Claim 1 wherein the means for generating produces an electrical pulse f selected rise and fall time constants and of selected duration. voltage and polarity.

13. The invention of Claim 1 wherein the means for generating the electrical pulse comprises means for scaling the voltage of the pulse in response to a selectable digital value.

14. The invention of Claim 1 wherein the apparatus further comprises means for directing the emitted diagnostic fluid along a desired path.

15. A method of dispensing precise quantities of diagnostic fluids comprising the steps of:

(a) generating an electrical pulse of predefined characteristics;

(b) reducing the volume of a chamber containing the diagnostic fluid by electro-mechanical means in response to the electrical pulse such that a droplet of fluid of known volume is propelled through an orifice in the chamber; and

(c) repeating steps (a) and (b) until a desired quantity of the diagnostic fluid has been dispensed

FIG. 1

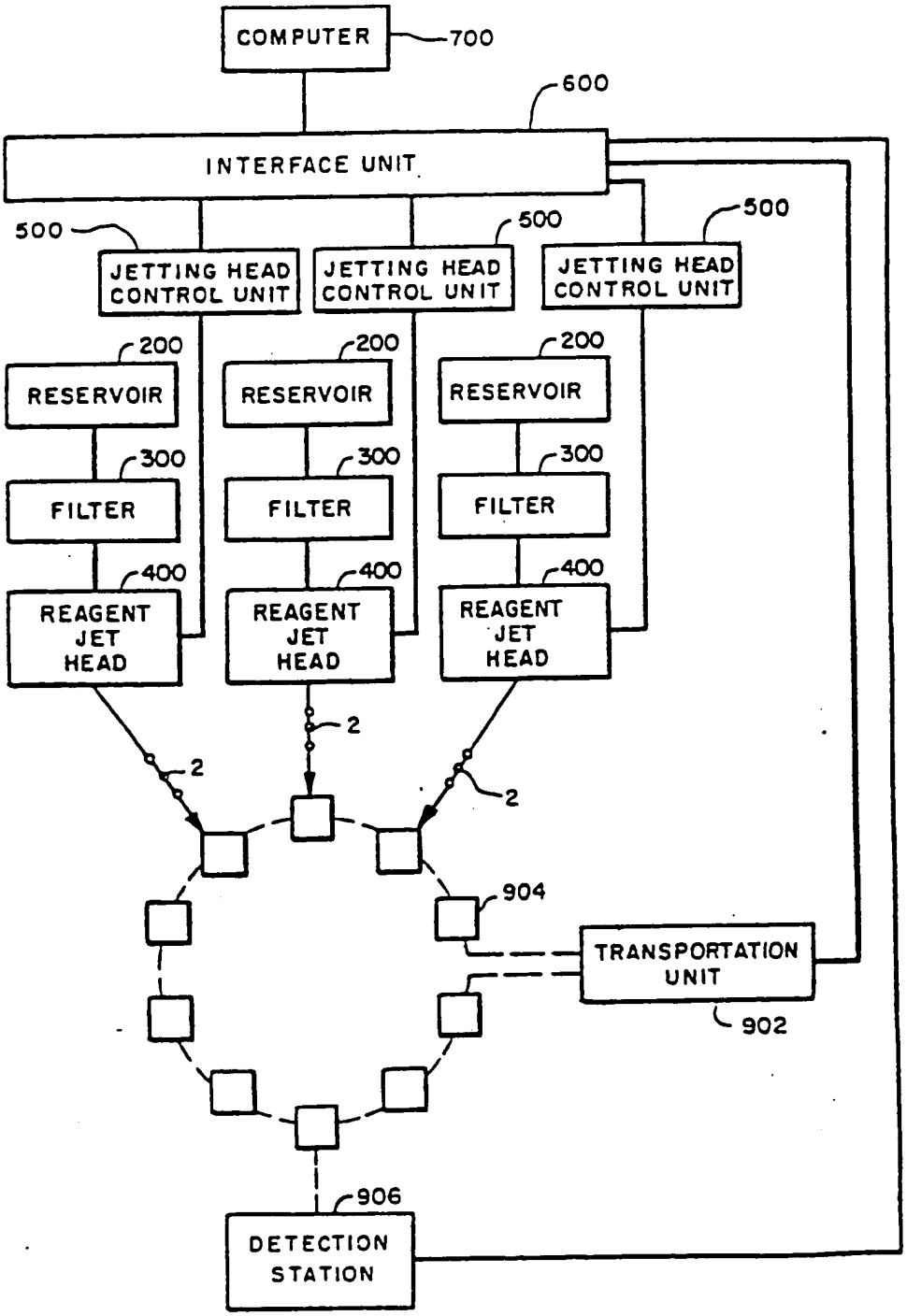

COMPUTER
700
600
INTERFACE UNIT
500
JETTING HEAD CONTROL UNIT
500
JETTING HEAD CONTROL UNIT
500
JETTING HEAD CONTROL UNIT
200
RESERVOIR
200
RESERVOIR
200
RESERVOIR
300
FILTER
300
FILTER
300
FILTER
400
REAGENT JET HEAD
400
REAGENT JET HEAD
400
REAGENT JET HEAD
2
2
2
904
TRANSPORTATION UNIT
902
906
DETECTION STATION

FIG. 2a

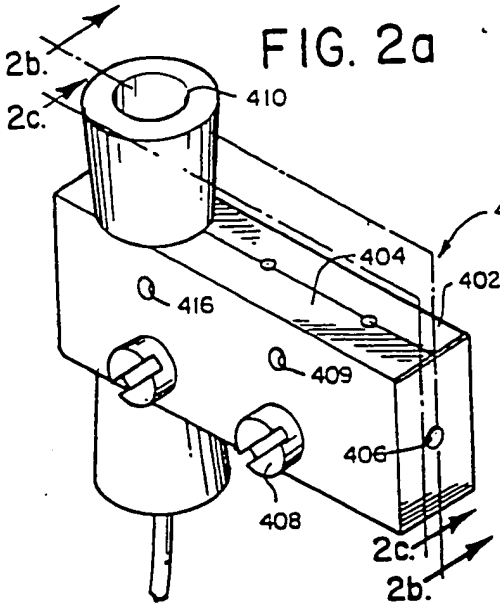


FIG. 2b

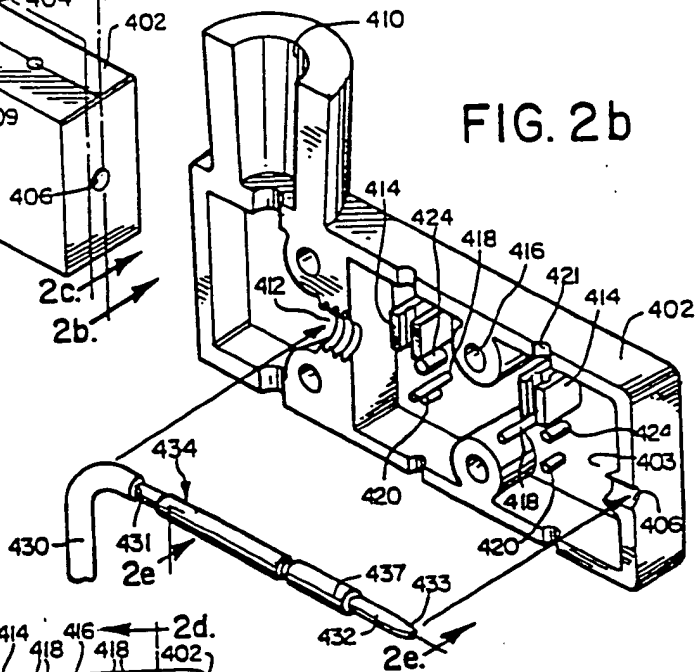
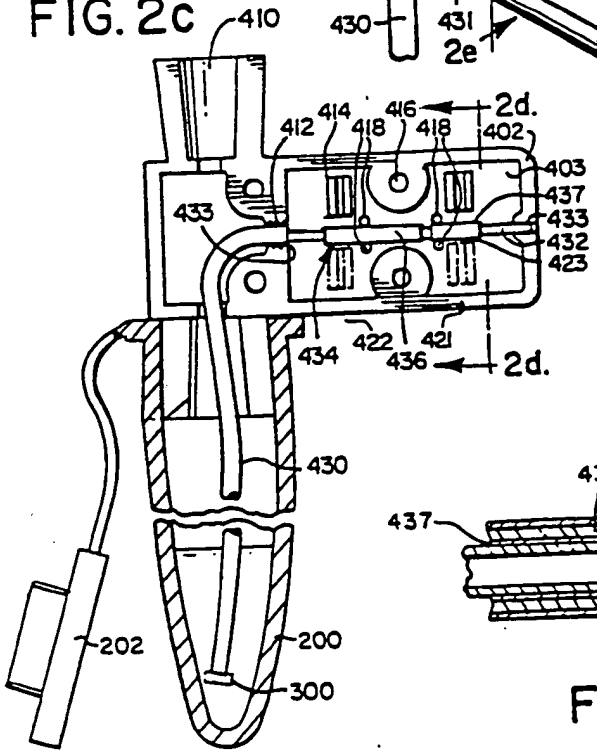


FIG. 2c



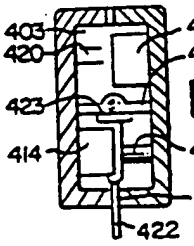


FIG. 2d

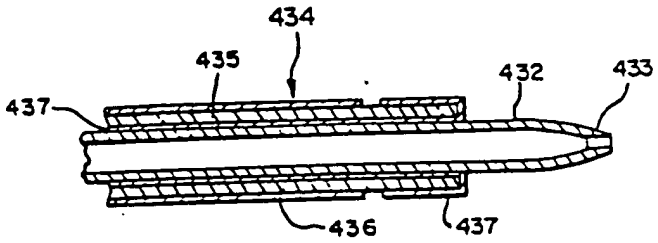
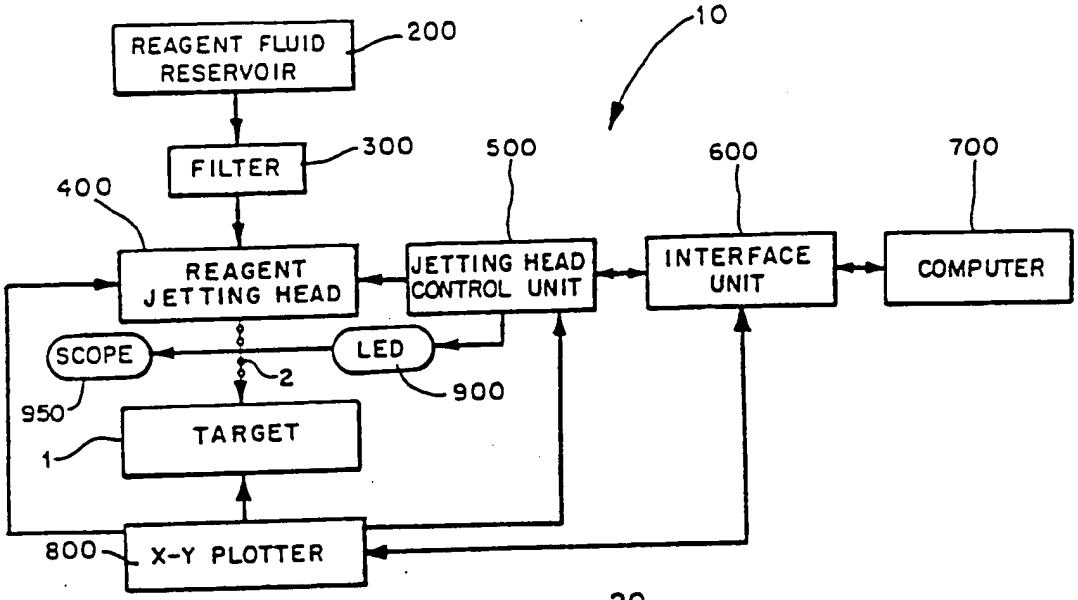


FIG. 2e

FIG. 3


10
REAGENT FLUID RESERVOIR
200
FILTER
300
400
500
600
700
REAGENT JETTING HEAD
JETTING HEAD CONTROL UNIT
INTERFACE UNIT
COMPUTER
SCOPE
LED
2
900
950
TARGET
1
800
X-Y PLOTTER

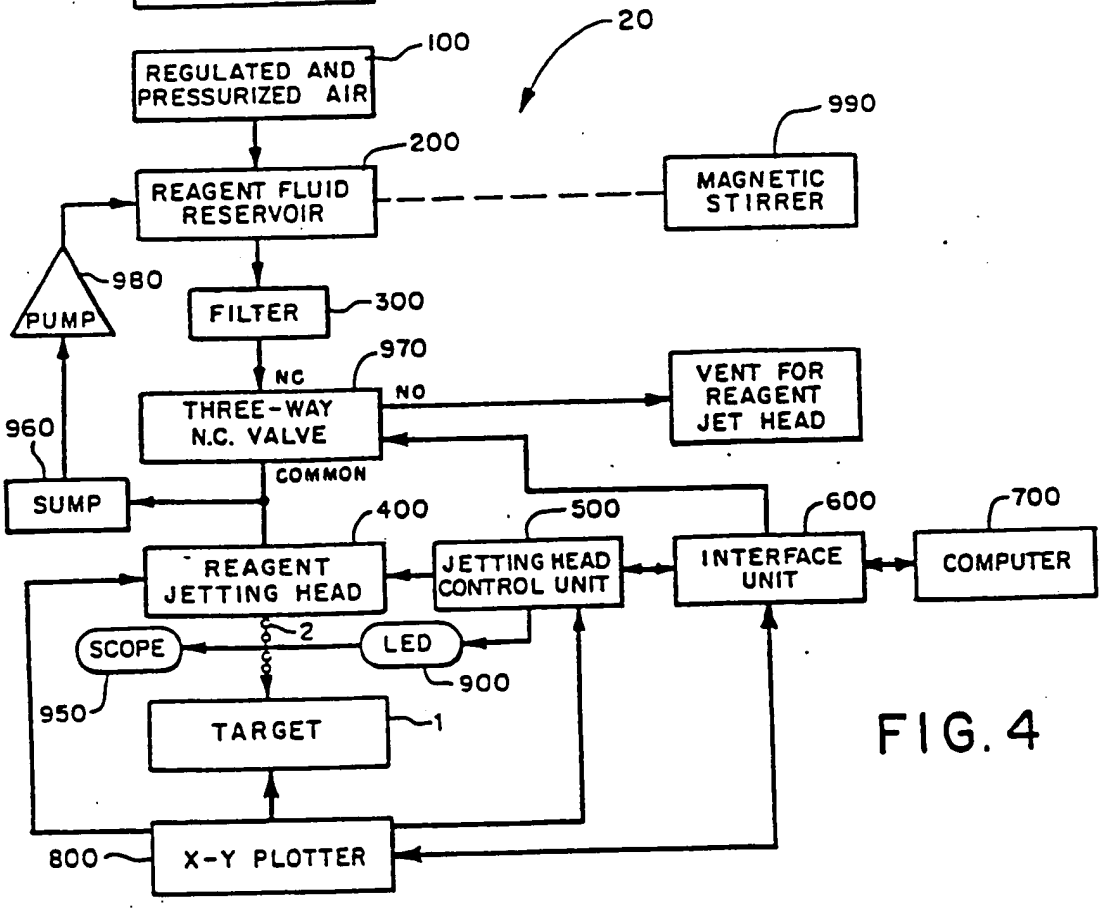

20
REGULATED AND PRESSURIZED AIR
100
990
200
REAGENT FLUID RESERVOIR
MAGNETIC STIRRER
980
PUMP
FILTER
300
970
NC
NO
THREE-WAY N.C. VALVE
VENT FOR REAGENT JET HEAD
960
COMMON
SUMP
400
500
600
700
REAGENT JETTING HEAD
JETTING HEAD CONTROL UNIT
INTERFACE UNIT
COMPUTER
SCOPE
LED
2
900
950
TARGET
1
800
X-Y PLOTTER

FIG. 4

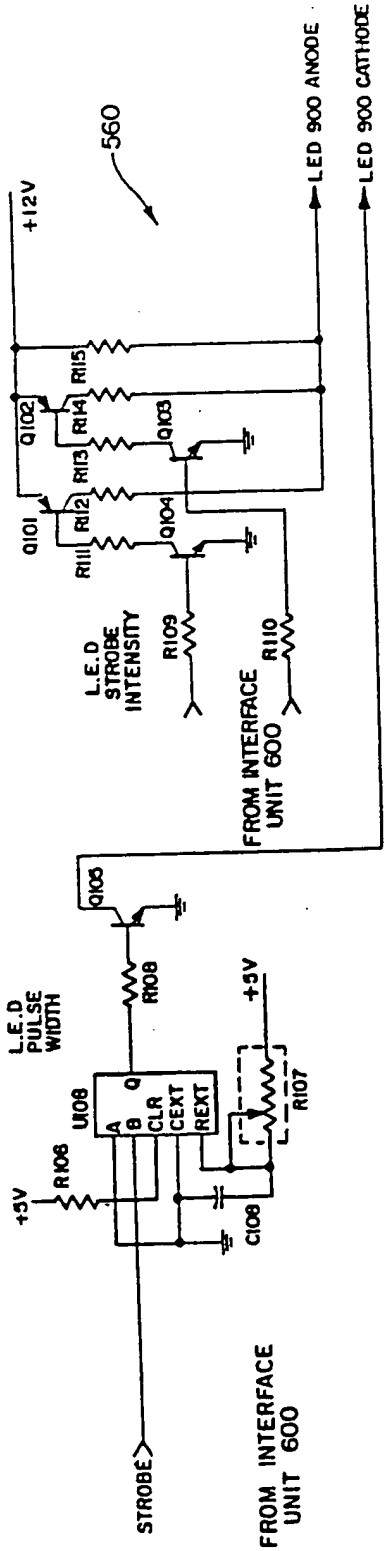

560
+12V
LED 900 ANODE
LED 900 CATHODE
Q101
Q102
Q103
Q104
Q105
R111
R112
R113
R114
R115
L.E.D STROBE INTENSITY
R109
R110
FROM INTERFACE UNIT 600
L.E.D PULSE WIDTH
R108
U108
A
B
Q
CLR
CEXT
REXT
+5V
R106
R107
C108
STROBE
FROM INTERFACE UNIT 600

FIG. 5a

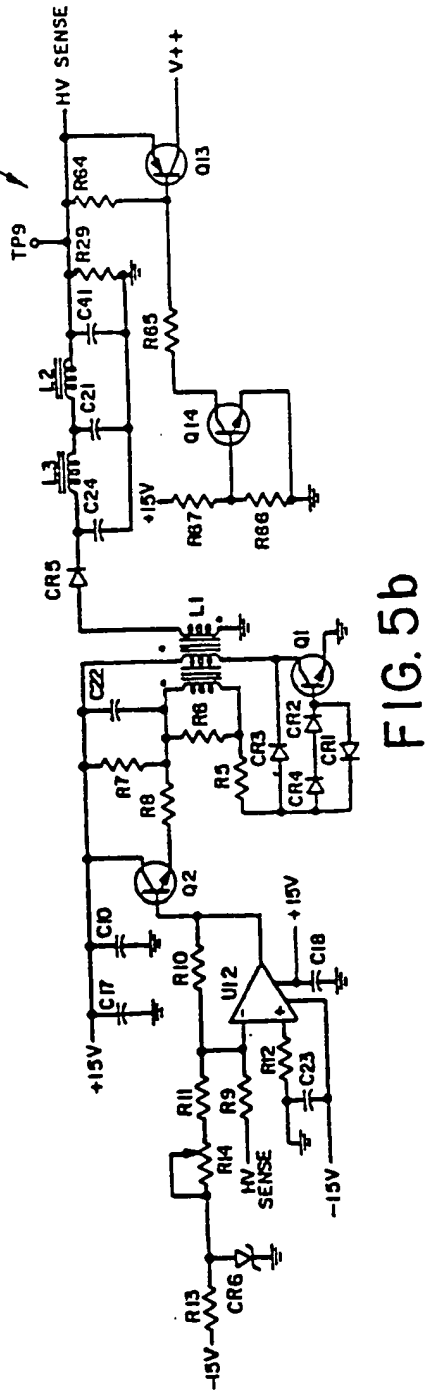

540
HV SENSE
V++
TP9
R64
R29
Q13
C41
R65
L2
C21
L3
C24
Q14
+15V
R87
R86
CR5
L1
Q1
C22
R6
CR2
CR3
CR1
CR4
R7
R8
R5
Q2
C10
C17
+15V
R10
U12
+15V
C18
R11
R9
R12
C23
R14
HV SENSE
-15V
R13
CR6
-15V

FIG. 5b

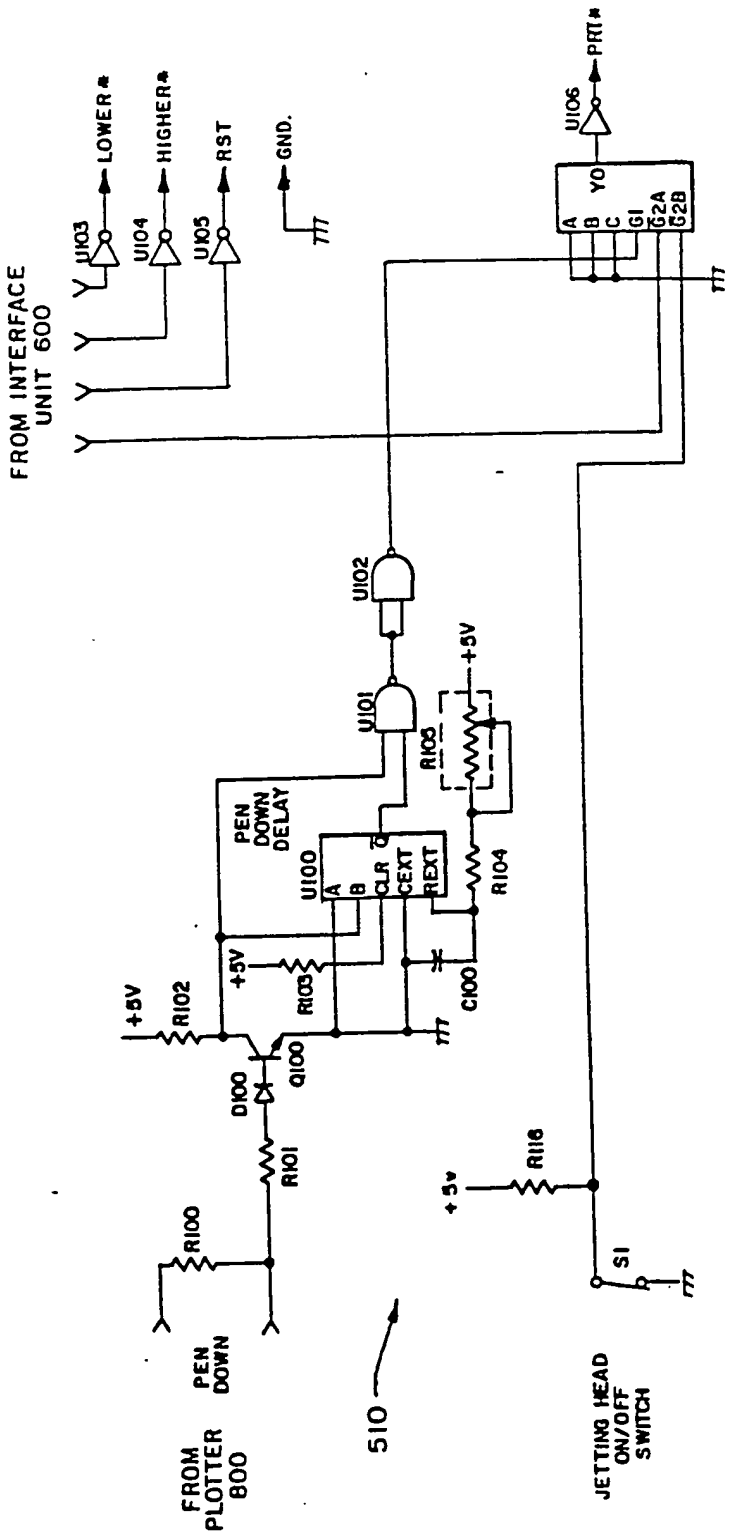

FROM INTERFACE UNIT 600
U103
U104
U105
LOWER#
HIGHER#
RST
GND.
U106
PRT#
YO
A
B
C
G1
G2A
G2B
U102
U101
+5V
R105
PEN DOWN DELAY
U100
CLR
CEXT
REXT
R104
C100
R103
R102
Q100
D100
R101
R100
R116
S1
FROM PLOTTER 800
PEN DOWN
510
JETTING HEAD ON/OFF SWITCH

FIG. 5c

FIG. 5d

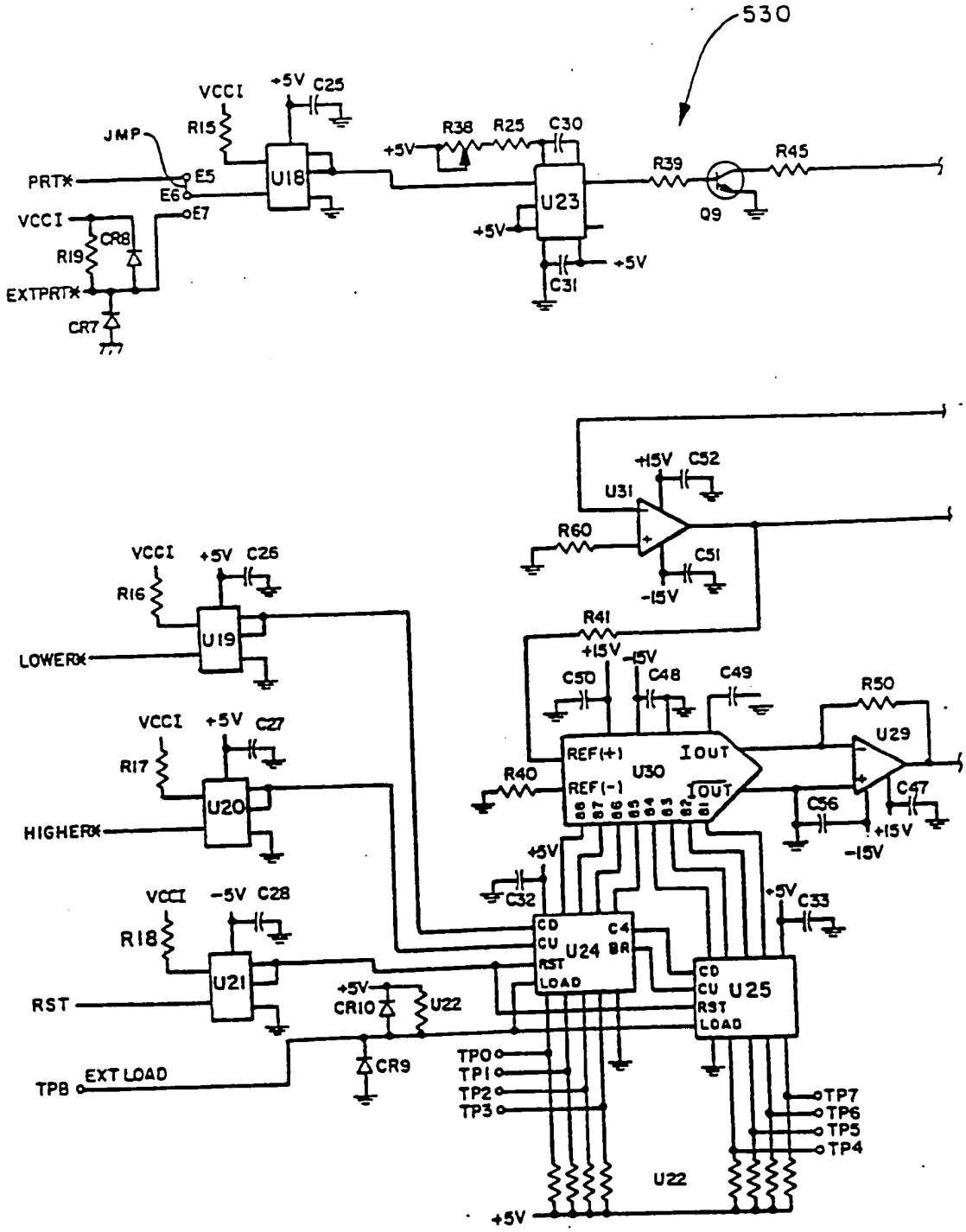

530
VCCI
+5V C25
R15
JMP
PRT*
E5
E6
E7
U18
R38 R25 C30
+5V
U23
R39
R45
Q9
+5V
C31
+5V
VCCI
CR8
R19
EXTPRT*
CR7
+15V C52
U31
R60
C51
-15V
R41
+15V -15V
C50 C48 C49
R50
U29
VCCI +5V C26
R16
U19
LOWER*
REF(+) IOUT
U30
REF(-) IOUT
R40
C56
C47
+15V
-15V
VCCI +5V C27
R17
U20
HIGHER*
+5V
C32
+5V C33
VCCI -5V C28
R18
U21
CD
CU
RST
LOAD
U24
C4
BR
CD
CU
RST
LOAD
U25
RST
+5V
CR10
U22
CR9
TP8
EXT LOAD
TP0
TP1
TP2
TP3
TP7
TP6
TP5
TP4
U22
+5V

FIG. 5e

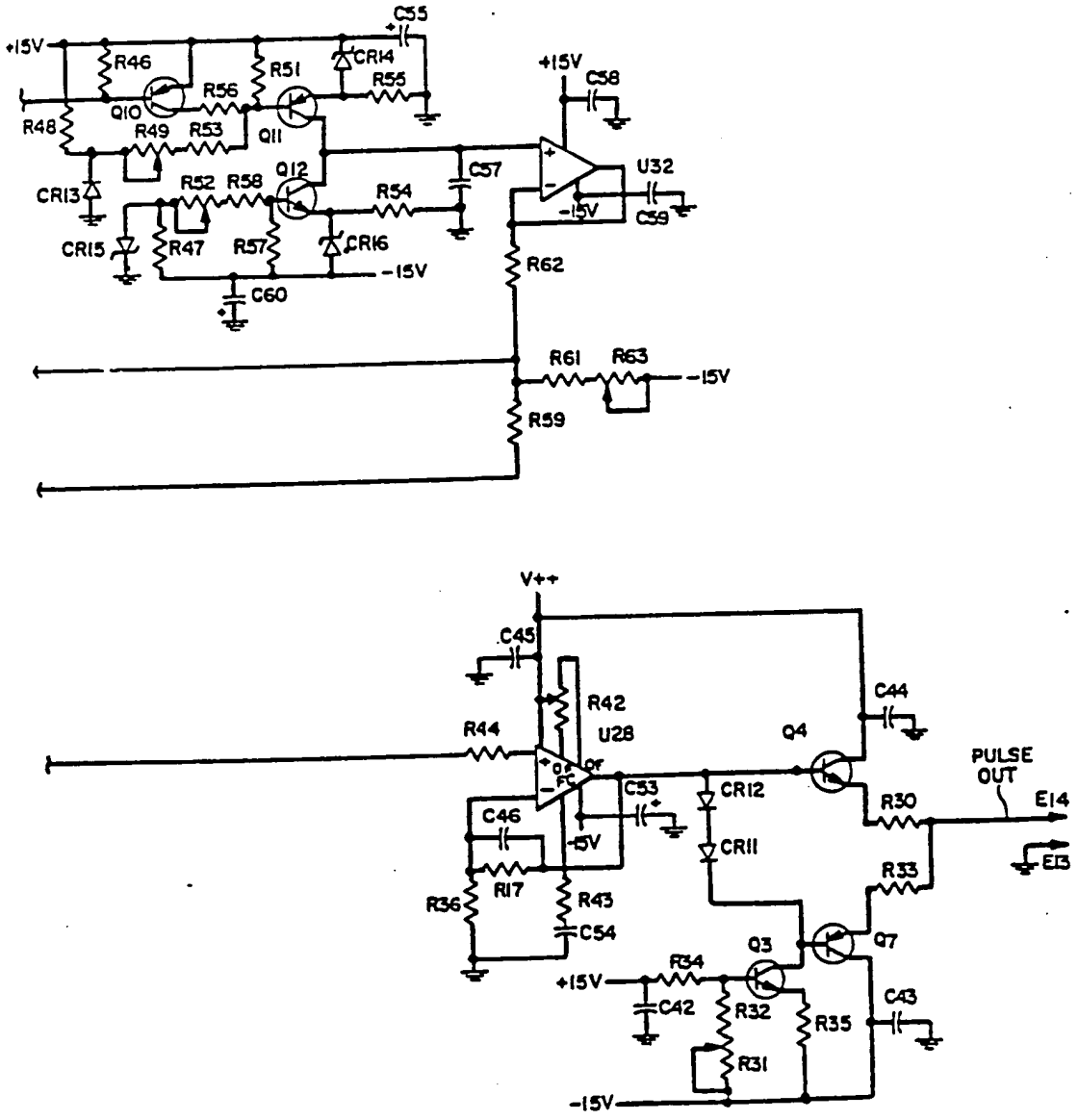

+15V
R46
Q10
R56
R51
CR14
C55
R55
R48
R49
R53
Q11
Q12
R52
R58
R54
C57
U32
C58
C59
CR13
CR15
R47
R57
CR16
-15V
C60
R62
R61
R63
R59
V++
C45
R42
U28
R44
Q4
C44
PULSE OUT
E14
E13
C46
C53
CR12
CR11
R30
R33
R36
R17
R43
C54
Q3
Q7
R34
C42
R32
R35
C43
R31

FIG. 6a

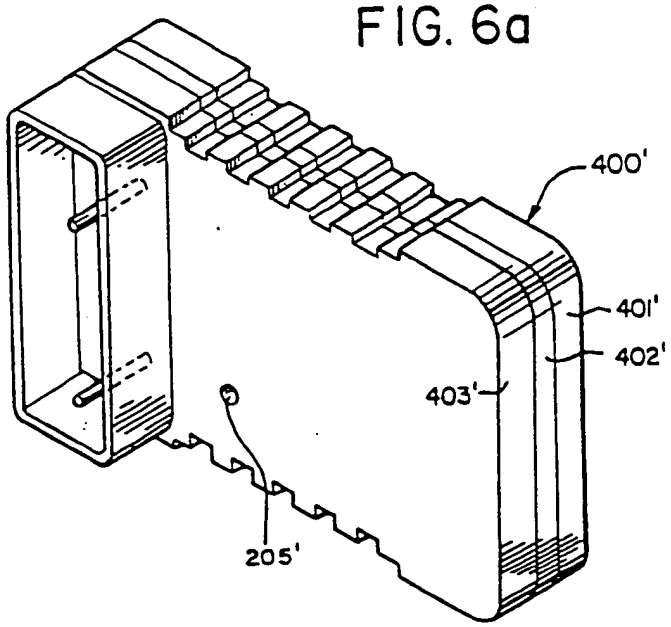


FIG. 7

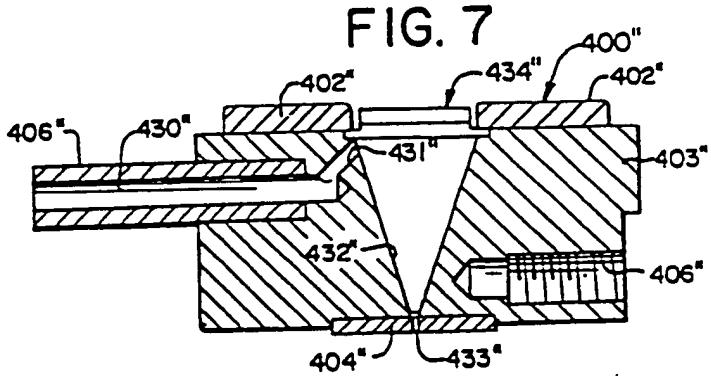
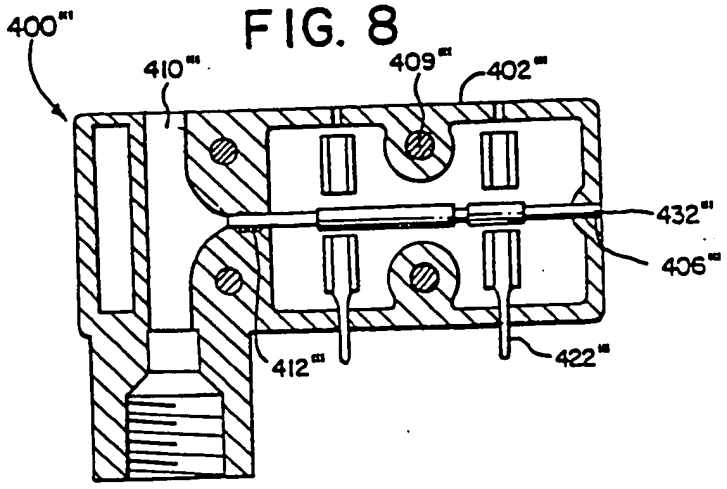


FIG. 8



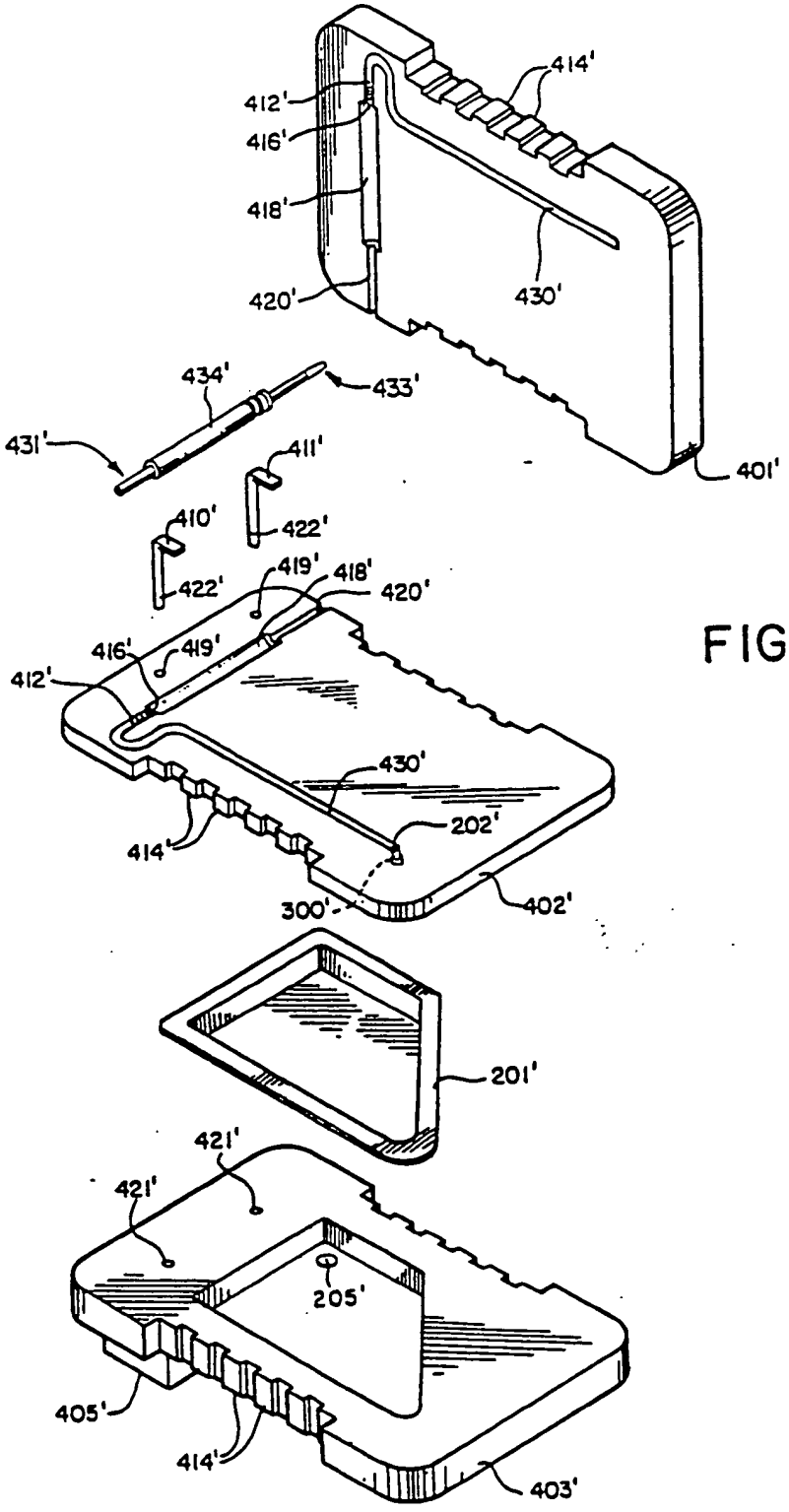

400'
414'
412'
416'
418'
420'
430'
401'
434'
433'
431'
411'
410'
422'
422'
419'
418'
420'
416'
419'
412'
430'
202'
414'
300'
402'
201'
421'
421'
205'
405'
414'
403'

FIG. 6b

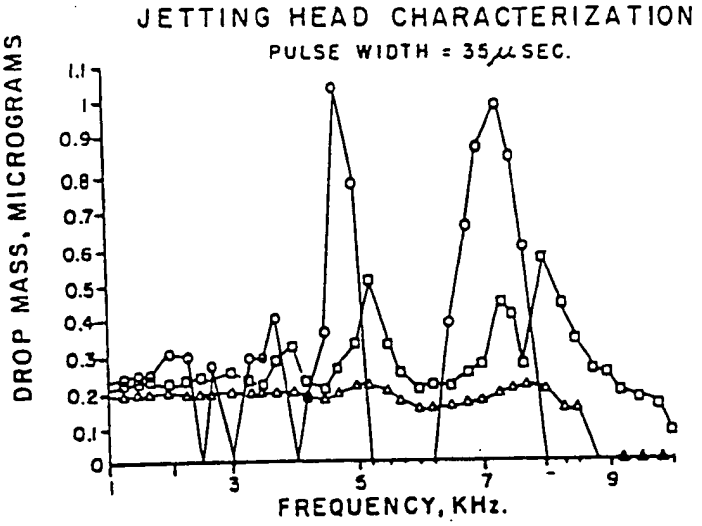


FIG. 9

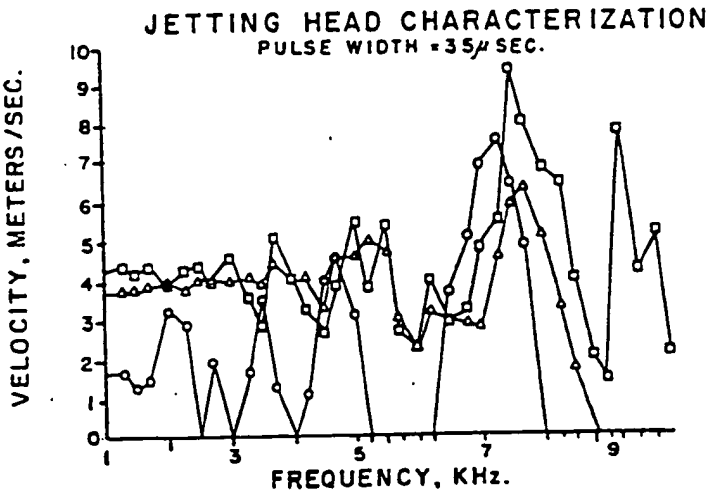


FIG. 10

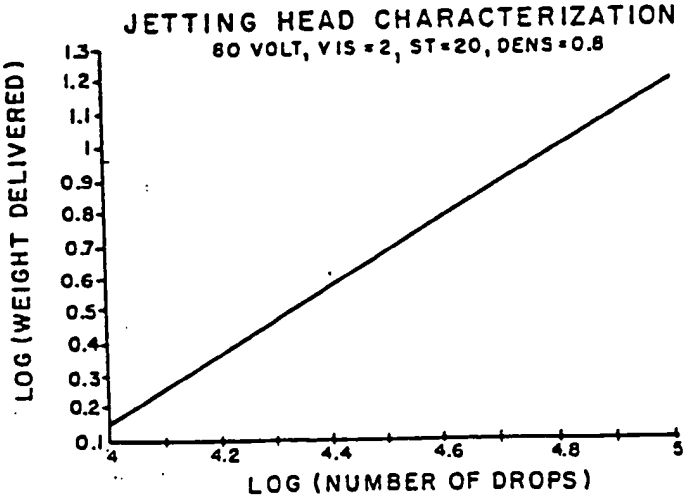


FIG. 11